

PROJECT MANUAL for

Colfax Economic Development
Corporation
Colfax-Mingo Childcare Center
Colfax, IA



PROJECT NO. 2025-055

00 0101 – TITLE SHEET

PROJECT MANUAL

SINGLE CONSTRUCTION CONTRACT for

**Colfax Economic Development Corporation –
Colfax-Mingo Childcare Center
Colfax, IA**

PROJECT NO. 2025-055

for
Colfax Economic Development Corporation
20 W Broadway
Colfax, IA 50054

Prepared by:

ATURA Architecture
912 North 13th Street
Clear Lake, IA 50428
Phone: 641-357-1923
E Mail: reedw@aturaarchitecture.com

I HEREBY CERTIFY THAT THESE PLANS
AND SPECIFICATIONS WERE PREPARED
BY ME OR UNDER MY DIRECT PERSONAL
SUPERVISION, AND THAT I AM A DULY
LICENSED ARCHITECT UNDER THE LAWS
OF IOWA.

REED WESSMAN, IA LIC.NO. 07278

Mechanical and Electrical Engineers:

KEDBluestone
5518 NW 88th Street
Johnston, IA 50131

Phone: 515-727-0700
E Mail: Kenny.Thelen@kedbluestone.com

Structural Engineers:

Apex Structural
373 Collins Rd NE # 102
Cedar Rapids, IA 52402

Phone: 319-294-2739
E Mail: natalya@apex-se.com

Civil Engineers:

Civil Design Advantage
4121 NW Urbandale Drive
Urbandale, IA 50322

Phone: 515-369-4400
E Mail: ErinO@cda-eng.com

Food Service Consultants:

Advanced Foodservice Consulting
6201 S. Gateway Drive
Marion, IA 52302

Phone: 319-440-0450
E Mail: mackenzieb@advancedfsc.com

Drawings Dated May 8, 2025
Project Manual Dated May 8, 2025

PRE-BID MEETING Thursday, May 22nd, 2025, 2:00 P.M., local time, at the Colfax City Council meeting room, 20 West Howard Street, Colfax, IA 50054.

BIDS DUE Thursday, June 5th, 2025, 2:00 P.M., local time, at the Colfax School District Office board room, 1000 North Walnut Street, Colfax, IA 50054.

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SINGLE CONSTRUCTION CONTRACT for

**Colfax Economic Development Corporation –
Colfax-Mingo Childcare Center
Colfax, IA**

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DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

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NOTICE TO BIDDERS

**Colfax Economic Development Corporation –
Colfax-Mingo Childcare Center
Colfax, IA**

PROJECT NO. 2025 - 055

Sealed Bids for a Single Construction Contract for the Colfax Economic Development Corporation – Colfax-Mingo Childcare Center, Colfax, IA, for the Colfax Economic Development Corporation of Colfax, IA, will be received in the Colfax School District Office board room, 1000 N. Walnut Street, Colfax, IA 50054, up to the hour of 2:00 P.M., local time, Thursday, June 5th, 2025, and after this time they will be publicly opened and read aloud.

The work for the project shall be accomplished under a Single Construction Contract and there will be a Single Bid to include all of the following:

1. General Construction.
2. Mechanical Construction, including: Plumbing, Heating, Ventilating, and Air Conditioning.
3. Electrical Construction, including: Power, Lighting, Communication, and Fire Safety.

On-site mobilization and construction shall begin no sooner than June 16, 2025. The Owner requires substantial completion for the project by March 28, 2026.

All bids shall be made on the printed forms attached to and made a part of the proposed Contract Documents. The proposed Contract Documents including the Drawings, and the Project Manual, pursuant to which the work must be done, will be on file and may be viewed after May 12th, 2025, at the Colfax District Office, 100 N. Walnut Street, Colfax, IA 50054. Copies, thereof, are also on file at the Office of the Architect, Atura Architecture, 912 North 13th Street, Clear Lake, IA. These Documents may be obtained after the aforementioned date by Prime Contractors upon request to the Architect and on the condition they be returned after the receipt of bids. There will be no Contract Document deposit.

All bids shall be on the basis of cash payment for the work.

Form of Contract to be used will be
Form of Contract to be used will be "The Standard Form of Agreement between Owner and Contractor, where the basis for payment is a Stipulated Sum", issued by the American Institute of Architects, AIA Document A101-2017.

Each Bid shall be accompanied by Bid Security, in a separate sealed envelope, in the form of either (1) cash, cashiers check or certified check or certified share draft drawing on a credit union in Iowa or chartered under the laws of the United States, in an amount equal to at least Five (5%) Percent of Project Bid Amount or (2) a Bid Bond executed by a corporation authorized to contract as a surety in the State of Iowa with the amount or penal sum of not less than Five (5%) Percent of Project Bid Amount. The bid security should be made payable to the Colfax Economic Development Corporation. Such bid security shall be forfeited to the Colfax Economic Development Corporation as liquidated damages in the event the successful bidder fails or refuses to enter into a Contract within ten (10) days after the Award of Contract and post bond satisfactory to said owner insuring the faithful fulfillment of the Contract pursuant to the provisions of this Notice and the other Contract Documents.

No bidder may withdraw their bid for at least thirty (30) days after the scheduled closing time for the receipt of bids.

The Colfax Economic Development Corporation of Colfax, IA, reserves the right to reject any or all bids and waive all informality and irregularity in connection therewith if the same is judged to be in their best interests, and to make a selection, including that of any Alternate Bids, that in their judgment is best suited for the purpose intended for the project.

Colfax Economic Development Corporation
Colfax, IOWA

By /s/ Tim Salmon
Director

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

SECTION 00 1100 – NOTICE TO BIDDERS

1.1 PROJECT AND LOCATION

**Colfax Economic Development Corporation –
Colfax-Mingo Childcare Center
Colfax, IA**

1.2 GENERAL INFORMATION

- A. Project Description – The Work of this project shall consist of a Single Construction Contract including but not limited to the following:
 - 1. General Construction.
 - 2. Mechanical Construction, including: Plumbing, Heating, Ventilating, and Air Conditioning.
 - 3. Electrical Construction, including: Power, Lighting, Communication, and Fire Safety.
- B. The Owner will receive sealed bids until 2:00 P.M., local time, on Thursday, June 5th, 2025, at the Colfax School District Office board room, 1000 N. Walnut Street, Colfax, IA. Bids received after that time will not be considered. No telephone, oral, telegraphic, facsimile bids or modifications will be accepted. Bids will be opened publicly.
- C. The Owner reserves the right to reject any or all bids and waive all informalities and irregularities in connection therewith if the same is judged to be in their best interests, and to make a selection, including that of any Alternate Bids, that in their judgment is best suited for the purpose intended for the project.

1.3 BID DOCUMENT AVAILABILITY

- A. Complete sets of bidding documents are available at the office of the Architect: Atura Architecture, 912 N 13th Street, Clear Lake, IA 641-357-1923. There is no contract document deposit.
- B. Drawings and Project Manuals will be available for use and inspection at:
 - 1. North Iowa Builders Exchange, 9 Federal Avenue North, Mason City, IA 50401
 - 2. Algona Builders Exchange, 123 E. State Street, Algona, IA 50511
 - 3. Austin Builders Exchange, 329 North Main, Ste. 102, Austin, MN 55912.
 - 4. Construction Update Plan Room, 521 3rd Avenue SW, Cedar Rapids, IA 52404
 - 5. Fort Dodge Plan Room, 24 N. 9th Street, Suite A, Fort Dodge, IA 50501
 - 6. Master Builders of Iowa, 221 Park Street, Box 695, Des Moines, IA 50309
- C. Except for documents issued to Bidder receiving award, all Bidding Documents shall be returned to the issuing office within 10 days following receipt of Bids.

1.4 INQUIRIES

- A. Submit inquires pertaining to the bidding documents to Reed Wessman, at Atura Architecture, 912 N 13th Street, Clear Lake, IA 641-357-1923 (voice), reedw@aturaarchitecture.com (e-mail).
- B. Replies which revise the Bidding Documents will be issued to all Bidding Document holders of record as Addenda to the Bidding Documents and will become a part of the Contract. The Architect and the Owner will not be responsible for oral clarifications.

1.5 PROJECT SCHEDULE

- A. Upon execution of the Owner-Contractor Agreement, and acceptable submittal of the Performance Bond, Labor and Material Bond, and Certificate of Insurance, the Owner shall issue a Notice to Proceed. Work shall begin within ten (10) calendar days after the date set forth in the Notice to Proceed. The Work shall include: submittal processing, ordering of materials, and general project administration and mobilization. On-site mobilization and construction shall begin no sooner than June 16, 2025. The Owner requires substantial completion for the project by March 28, 2026. Final completion within seven (7) calendar days of the substantial completion date.

1.6 SUBMISSION OF BID

- A. The Bid shall be on a copy of the form provided in the Bidding Documents. The Bid shall be enclosed in an envelope, bearing Bidder's name, endorsed as follows:

SEALED BID

PROJECT NO. 2025-055 – Colfax Economic Development Corporation –
Colfax-Mingo Childcare Center,
Colfax, IA

- B. The Bid Security shall be enclosed in a separate envelope, bearing Bidder's name, endorsed as follows:

BID SECURITY

PROJECT NO. 2025-055– Colfax Economic Development Corporation –
Colfax-Mingo Childcare Center,
Colfax, IA

(Bidders shall submit duplicate copies of the Bid Security).

- C. The Bidder Status Form may be enclosed in a separate envelope or be included in with the Sealed Bid or Bid Security. This document will be required to be submitted prior to award of the Contract, but will not be grounds for disqualification of the Bid if not submitted at bid opening time.
- D. Bid Security and Performance Bond & Material and Labor Payment Bond:

1. Each Bidder shall accompany its bid with bid security in a separate sealed envelope, in the amount of five percent (5%) of the Bid (including Alternates), 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 Performance Bond & Material and Labor Payment Bond, in form acceptable to the Owner, for the faithful performance of the contract, in an amount equal to one hundred percent of the amount of the proposal. The bidder's security shall be in the form of a cashier's check, a certified check, or a bank money order drawn on a FDIC insured bank in Iowa or on a 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 AIA Document A310 with corporate surety satisfactory to the Owner. The bid shall contain no condition except as provided in the specifications. All Proposals and Bid Securities must have original signatures.

- E. Qualification of Bidders and Bids:

1. An out-of-state bidder, if awarded a contract, will be required to submit evidence of authorization to do business in the State.

- F. An unincorporated out-of-state contractor will be required to furnish evidence of State Department of Revenue's receipt of bond guaranteeing payment of state income taxes on profit from project, for each year during construction.
- G. The Owner reserves the right to waive irregularities and to reject bids in whole or in part. The Bidder shall include all requested Forms and attachments with their submission of the Bid Form; failure to comply may be cause for rejection. No modification of submitted bids will be permitted in any form.
- H. No bid may be withdrawn for a period of thirty (30) days after the date of bid opening.

END OF SECTION 00 1100

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

SECTION 00 2000 – INSTRUCTIONS TO BIDDERS

1.1 GENERAL

- A. To be considered, Bids must be made in accordance with these Instructions to Bidders and items included on the Bid Form.
- B. AIA Document A701 – Instructions to Bidders (2017 Edition) forms the basis for Bidding for a Contract between the Owner and Contractor. Provisions, not superseded or amended below, remain in full force and effect.
- C. A copy of AIA Document A701 shall be provided by the Architect upon request.

1.2 INQUIRIES

- A. Submit inquiries pertaining to the Bidding Documents to Reed Wessman, Atura Architecture, 912 N 13th Street, Clear Lake, IA 641-357-1923 (voice), reedw@aturaarchitecture.com (e-mail).
- B. Replies which revise the Bidding Documents will be issued to all Bidding Document holders of record as Addenda to the Bidding Documents and will become a part of the Contract. The Architect and the Owner will not be responsible for oral clarifications.

1.3 PRE-BID CONFERENCE

- A. A Pre-Bid Conference and tour will be held at 2:00 P.M., on Thursday, May 22nd, 2025, at the City Council Meeting Room, 20 W Howard St, Colfax, IA to answer questions or discuss matters pertaining to project. Bidders shall meet at this location. A tour of the project site will immediately follow the meeting. Interpretations and agreed changes, resulting from meeting, will be included in an Addendum. The Architect will be present.

1.4 SUBSTITUTIONS

- A. Substitute products will be considered in accordance with Section 01 6000, and as follows.
- B. Where Bidding Documents stipulate a specific product, a substitute product will be considered when written request is received by the Architect by date specified as follows:
 - 1. Prior to the Bid Date, substitution requests will be considered if received on or before 2:00 p.m., Monday, June 2, 2025.
 - 2. If circumstances do not permit a request to be submitted prior to Bid Date, the proposed substitution may be submitted after the Contract is awarded only under circumstances set forth in Section 01 6000. All such Substitution Requests shall include the value of additions to or deductions from the Contract amount, including the value of revisions to other work required to accommodate the substitution.
 - 3. **Product substitutions must be submitted on the project “Substitution Request Form”. See Section 01 6000.**
- C. Each request shall clearly describe the product for which approval is asked, and shall include all data necessary to demonstrate acceptability, as outlined in Section 01 6000.
- D. The Architect/Engineer will list acceptable products in an Addendum.

1.5 BASIS OF BIDS

- A. The Bidder shall include all requested Forms and attachments with their submission of the Bid Form; failure to comply may be cause for rejection.
 - 1. Bid submissions shall include all requested Allowance amounts, Bid Alternate costs, and identified Unit Prices.
- B. Bid shall include all applicable costs associated with providing a free and clear product to the Owner including, but not restricted to, applicable taxes, crating, shipping costs, delivery to site, and installation costs.
- C. In the case of an inconsistency between Drawings, Specifications, and/or Addendum, or within any of the Documents, and not clarified by an Addendum, the better quality, greater quantity, or more stringent requirement of Work shall be provided in accordance with the Architect's interpretation.
- D. No modification of submitted bids will be permitted in any form.

1.6 PERFORMANCE BOND & LABOR AND MATERIAL PAYMENT BOND

- A. Contractor shall furnish a Performance Bond and Labor and Material Payment Bond, after receipt of bids and before execution of the Contract, in the amount of the full Contract Sum, on AIA Form A312, including an attached rider stating "It is hereby understood and agreed any suit under this bond must be instituted by the Contractor before the expiration of two (2) years from the date on which final payment under the Contract falls due."
- B. The bonds shall be issued by a responsible surety company authorized to do business in the State of Iowa as indicated in Section 00 1100 – Notice to Bidders.
- C. The amount of the bonds shall be increased to cover additions made to the Contract during execution of the Work.
- D. The cost of the bonds shall be included in the proposed Contract Sum.
- E. The bonds shall be for a two (2) year period, commencing on the date of final completion.

1.7 SUBCONTRACTORS

- A. The bidder is specifically advised that any person, firm or other party to whom it is proposed to award a subcontract under this contract:
 - 1. Must be acceptable to the Owner.
 - 2. Must comply with the Bidding Requirements, Conditions of the Contract, and the applicable Technical Specifications and Drawings.

1.8 QUALIFICATION OF BIDDER

- A. The Owner may make such investigations as are deemed necessary to determine the ability of the bidder to perform the work and the bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of, such bidder fails to satisfy the Owner that such bidder is properly qualified to carry out the obligation of the contract and to complete the work contemplated therein. Conditional bids will not be accepted.

1.9 BID SECURITY

- A. Each Bid must be accompanied by a Bid Security as identified in the Notice to Bidders.
- B. The Bid Security will be returned to all except the three lowest bidders within three (3) days after the opening of bids, and the remaining cash or checks will be returned promptly after the Owner and the accepted bidder have executed the contract, or, if no award has been made within thirty (30) days after the date of the opening of bids, upon demand by the bidder at any time thereafter, so long as they have not been notified of the acceptance of their bid.

1.10 LIQUIDATED DAMAGES FOR FAILURE TO ENTER INTO CONTRACT

- A. The successful bidder, upon their failure or refusal to execute and deliver the contract and bonds required within 10 days after they have received notice of the acceptance of their bid, shall forfeit to the Owner, as liquidated damages for such failure or refusal, the security deposited with their bid.

1.11 METHOD OF AWARD

- A. Bid opening will be an open public letting. Bidders will be informed of Bid results.
- B. The Owner may reject any or all bids, waive irregularities or informalities in any bid.
- C. Contractor shall be considered awarded when the selected bidder receives a written notice from the Owner.

1.12 INSURANCE

- A. Contractor shall provide a certificate of insurance for Contractor's liability insurance with the minimum coverages and requirements as designated in SECTION 00 8000 – SUPPLEMENTARY CONDITIONS, Article 11.1.
- B. The Owner shall be responsible for Property Insurance (Builder's Risk), with Subcontractors, and Sub-subcontractors listed as "additional insured".

1.13 FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR

- A. The Form of Contract to be used will be "The Standard Form of Agreement between Owner and Contractor, where the basis for payment is a Stipulated Sum", issued by the American Institute of Architects, AIA Document A101-2017

1.14 BIDDER STATUS FORM

- A. The Contractor shall submit with their Bid, the "Bidder Status Form", which is included on pages 6-7 of this SECTION. Failure to submit a fully completed Bidder Status Form with the bid may result in the bid being deemed non-responsive and rejected.

1.15 FEDERAL GOVERNMENT REQUIREMENTS

- A. The project is funded by the Child Care Business Incentive Grant (American Rescue Plan Act of 2021). As such, there are specific government requirements. See accompanying "Certification Regarding Contract Provisions for Non-Federal Entity Contracts Under Federal Awards - Appendix II of 2 CFR Part 200" and "44 C.F.R. PART 18 APPENDIX A – CERTIFICATION REGARDING LOBBYING"

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 nonresident 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: _____
City, State, Zip: _____

Dates: ____/____/____ to ____/____/____ Address: _____
City, State, Zip: _____

Dates: ____/____/____ to ____/____/____ Address: _____
City, State, Zip: _____

You may attach additional sheet(s) if needed.

To be completed by non-resident bidders

Part C

- Name of home state or foreign country reported to the Iowa Secretary of State: _____
- Does your company's home state or foreign country offer preferences to resident bidders, resident labor force preferences or any other type of preference to bidders or laborers? ☐ Yes ☐ No
- 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: _____

You must submit the completed form to the governmental body requesting bids per 875 Iowa Administrative Code Chapter 156. This form has been approved by the Iowa Labor Commissioner.

309-6001 (09-15)

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.

- | | |
|--|---|
| <input type="checkbox"/> Yes <input type="checkbox"/> No | My business is currently registered as a contractor with the Iowa Division of Labor. |
| <input type="checkbox"/> Yes <input type="checkbox"/> No | My business is a sole proprietorship and I am an Iowa resident for Iowa income tax purposes. |
| <input type="checkbox"/> Yes <input type="checkbox"/> 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. |
| <input type="checkbox"/> Yes <input type="checkbox"/> 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. |
| <input type="checkbox"/> Yes <input type="checkbox"/> 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. |
| <input type="checkbox"/> Yes <input type="checkbox"/> 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. |
| <input type="checkbox"/> Yes <input type="checkbox"/> 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. |
| <input type="checkbox"/> Yes <input type="checkbox"/> 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. |
| <input type="checkbox"/> Yes <input type="checkbox"/> 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. |
| <input type="checkbox"/> Yes <input type="checkbox"/> No | My business is a limited liability company whose certificate of organization is filed in Iowa and has not filed a statement of termination. |
| <input type="checkbox"/> Yes <input type="checkbox"/> 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. |

309-6001 (09-15)

***Certification Regarding Contract Provisions for Non-Federal Entity Contracts Under
Federal Awards
Appendix II of 2 CFR Part 200***

In addition to other provisions required by the Federal agency or non-Federal entity, all contracts made by the non-Federal entity under the Federal award must contain provisions covering the following, as applicable.

(A) Contracts for more than the simplified acquisition threshold, which is the inflation adjusted amount determined by the Civilian Agency Acquisition Council and the Defense Acquisition Regulations Council (Councils) as authorized by 41 U.S.C. 1908, must address administrative, contractual, or legal remedies in instances where contractors violate or breach contract terms, and provide for such sanctions and penalties as appropriate.

(B) All contracts in excess of \$10,000 must address termination for cause and for convenience by the non-Federal entity including the manner by which it will be effected and the basis for settlement.

(C) Equal Employment Opportunity. Except as otherwise provided under 41 CFR Part 60, all contracts that meet the definition of “federally assisted construction contract” in 41 CFR Part 60-1.3 must include the equal opportunity clause provided under 41 CFR 60-1.4(b), in accordance with Executive Order 11246, “Equal Employment Opportunity” (30 FR 12319, 12935, 3 CFR Part, 1964-1965 Comp., p. 339), as amended by Executive Order 11375, “Amending Executive Order 11246 Relating to Equal Employment Opportunity,” and implementing regulations at 41 CFR part 60, “Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor.”

(D) Davis-Bacon Act, as amended (40 U.S.C. 3141-3148). When required by Federal program legislation, all prime construction contracts in excess of \$2,000 awarded by non-Federal entities must include a provision for compliance with the Davis-Bacon Act (40 U.S.C. 3141-3144, and 3146-3148) as supplemented by Department of Labor regulations (29 CFR Part 5, "Labor Standards Provisions Applicable to Contracts Covering Federally Financed and Assisted Construction"). In accordance with the statute, contractors must be required to pay wages to laborers and mechanics at a rate not less than the prevailing wages specified in a wage determination made by the Secretary of Labor. In addition, contractors must be required to pay wages not less than once a week. The non-Federal entity must place a copy of the current prevailing wage determination issued by the Department of Labor in each solicitation. The decision to award a contract or subcontract must be conditioned upon the acceptance of the wage determination. The non-Federal entity must report all suspected or reported violations to the Federal awarding agency. The contracts must also include a provision for compliance with the Copeland "Anti-Kickback" Act (40 U.S.C. 3145), as supplemented by Department of Labor regulations (29 CFR Part 3, "Contractors and Subcontractors on Public Building or Public Work Financed in Whole or in Part by Loans or Grants from the United States"). The Act provides that each contractor or subrecipient must be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation to which he or she is otherwise entitled. The non-Federal entity must report all suspected or reported violations to the Federal awarding agency.

(E) Contract Work Hours and Safety Standards Act (40 U.S.C. 3701-3708). Where applicable, all contracts awarded by the non-Federal entity in excess of \$100,000 that involve the employment of mechanics or laborers must include a provision for compliance with 40 U.S.C. 3702 and 3704, as supplemented by Department of Labor regulations (29 CFR Part 5). Under 40 U.S.C. 3702 of the Act, each contractor must be required to compute the wages of every mechanic and laborer on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that the worker is compensated at a rate of not less than one and a half times the basic rate of pay for all hours worked in excess of 40 hours in the work week. The requirements of 40 U.S.C. 3704 are applicable to construction work and provide that no laborer or mechanic must be required to work in surroundings or under working conditions which are unsanitary, hazardous or dangerous. These requirements do not apply to the purchases of supplies or materials or articles ordinarily available on the open market, or contracts for transportation or transmission of intelligence.

(F) Rights to Inventions Made Under a Contract or Agreement. If the Federal award meets the definition of “funding agreement” under 37 CFR § 401.2 (a) and the recipient or subrecipient wishes to enter into a contract with a small business firm or nonprofit organization regarding the substitution of parties, assignment or performance of experimental, developmental, or research work under that “funding agreement,” the recipient or subrecipient must comply with the requirements of 37 CFR Part 401, “Rights to Inventions Made by Nonprofit Organizations and Small Business Firms Under Government Grants, Contracts and Cooperative Agreements,” and any implementing regulations issued by the awarding agency.

(G) Clean Air Act (42 U.S.C. 7401-7671q.) and the Federal Water Pollution Control Act (33 U.S.C. 1251-1387), as amended - Contracts and subgrants of amounts in excess of \$150,000 must contain a provision that requires the non-Federal award to agree to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401-7671q) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251-1387). Violations must be reported to the Federal awarding agency and the Regional Office of the Environmental Protection Agency (EPA).

(H) Debarment and Suspension (Executive Orders 12549 and 12689) - A contract award (see 2 CFR 180.220) must not be made to parties listed on the governmentwide exclusions in the System for Award Management (SAM), in accordance with the OMB guidelines at 2 CFR 180 that implement Executive Orders 12549 (3 CFR part 1986 Comp., p. 189) and 12689 (3 CFR part 1989 Comp., p. 235), "Debarment and Suspension." SAM Exclusions contains the names of parties debarred, suspended, or otherwise excluded by agencies, as well as parties declared ineligible under statutory or regulatory authority other than Executive Order 12549.

(I) Byrd Anti-Lobbying Amendment (31 U.S.C. 1352) - Contractors that apply or bid for an award exceeding \$100,000 must file the required certification. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining any Federal contract, grant or any other award covered by 31 U.S.C. 1352. Each tier must also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the non-Federal award.

Name of Vendor, Contractor, or Subgrantee: _____

Signature: _____

Name of Authorized Signatory: _____

Title: _____

Date: _____

“44 C.F.R. PART 18 APPENDIX A – CERTIFICATION REGARDING LOBBYING”

Certification for Contracts, Grants, Loans, and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

- (1) No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any federal contract, the making of any federal grant, the making of any federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any federal contract, grant, loan, or cooperative agreement.
- (2) If any funds other than federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, “Disclosure Form to Report Lobbying,” in accordance with its instructions.
- (3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

Signature of Contractor’s Authorized Official

Name and Title of Contractor’s Authorized Official

Date

END OF SECTION 00 2000

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

SECTION 00 3000 – INFORMATION AVAILABLE TO BIDDERS

Information available to bidders is made available for the bidder's reference in preparing bids, but is not part of the Contract Documents and does not relieve the bidder from doing their own investigation to determine the existing conditions of the site.

A. SITE SURVEY

1. A site survey has been prepared as a service to the Owner. The survey is included in the Project Drawings.
2. This survey identifies existing utilities and grade elevations and was prepared primarily for the use of the Architect/Engineer in establishing new grades, identifying natural water shed, utility connections, and modifications.

B. INTERPRETATION

1. No representation or warranty is made by the Architect or the Owner of the adequacy or contents of this Information Available to Bidders.
2. Information Available to Bidders is not a part of the Contract Documents.

END OF SECTION 00 3000

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

SECTION 00 4000 – BID FORM

(NOTE: Submit Bid with Bid Security attached in Separate Envelope).

**Colfax Economic Development Corporation –
Colfax-Mingo Childcare Center
Colfax, IA**

PROJECT NO. 2025-055

Date: _____

Bidder's Full Name (Company Name): _____

Bidder's Full Address: _____

Authorized Signature: _____

Printed Name and Title: _____

NOTE: Submit a copy of this Bid Form. All blanks shall be completed. Only bids on this form will be accepted.

1. The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an agreement with the Owner to perform and furnish all Work as specified or indicated in the Contract Documents for the Bid Price and within the schedule indicated in this Bid and in accordance with the other terms and conditions of the Contract Documents. Bidder accepts all of the terms and conditions of the Instructions to Bidders. This Bid will remain subject to acceptance for forty-five (45) days after the day of bid opening.

2. Accompanying this proposal is the Bid Security (Bid Bond, Certified Check, Certified Share Draft, Cashier's Check or Cash) required to be furnished by the Contract Documents, the same being subject to forfeiture in the event of default by the undersigned in accordance with the terms of the specifications.

3. Bidder has examined and carefully studied the Bid Documents and the following Addenda, receipt of all which is hereby acknowledged:

Addenda Number	Date
_____	_____
_____	_____
_____	_____

4. Bidder has visited the site and become familiar with and is satisfied as to the general, local and site conditions that may affect cost, progress, performance and furnishing of the Work.
5. Bidder is familiar with and is satisfied as to all federal, state and local laws and regulations that may affect cost, progress, performance and furnishing of the Work.
6. The Bid will not be withdrawn for thirty (30) days after the opening thereof.
7. The Bidder shall not make any revisions to the bid forms and shall not devise any alternates other than those provided. Any such notes, revisions, or comments may be grounds for rejection of the bid as not being responsive.

8. The Bidder acknowledges that they will obtain all required permits with local, State and Federal agencies as needed to complete all aspects of the project.
9. The Bidder acknowledges that they are registered with the Iowa Labor Commissioner at the time the bid is submitted to the Owner and has included said number above.
10. We shall execute a Contract and present Bonds within ten (10) days after formal written notice of award for the above stated compensation
11. We shall execute and pay premium on and deliver to the Architect, satisfactory bonds in the form stated. The bonds shall be in the full amount of the contract price, extending from the date of final completion to a date two (2) years later than the date of final completion.
12. We shall furnish all insurance certificates before entering or starting work at the site.
13. **If this Bid is accepted, we will substantially complete the Work on or before March 28th, 2025 with the final completion within seven (7) calendar days of the substantial completion date.**

BASE BID AMOUNT (written): _____

DOLLARS...\$ _____

Alternate No. 1 – Add landscaping wall/monument sign..... ADD... \$ _____

Unit Price No. 1 – Cost per cu.yd. of over-excavation,
engineered fill, and compaction..... ADD... \$ _____

LIST OF MAJOR SUBCONTRACTORS TO BE USED:
(To be completed within 24 hours after submission of bid)

	<u>NAME</u>	<u>CITY & STATE</u>
<u>EXCAVATION</u>		
<u>WOOD STUD/GYPSUM BOARD</u>		
<u>EIFS</u>		
<u>CONCRETE</u>		
<u>CASEWORK</u>		
<u>ROOFING</u>		
<u>DOORS & FRAMES</u>		
<u>FLOORING</u>		
<u>PAINTING</u>		
<u>HVAC</u>		
<u>PLUMBING</u>		
<u>ELECTRICAL</u>		

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

SECTION 00 6500 – CERTIFICATE OF INSURANCE

1.1 GENERAL CONDITIONS

A. The following documents are a part of the Contract:

1. Certificate of Insurance: AIA G715-2017.

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

SECTION 00 7000 – FEDERAL GOVERNMENT REQUIREMENTS

1.1 GENERAL CONDITIONS

A. The following documents are a part of the Contract:

4- Wage Rate Requirements: See Davis-Bacon Wages 2025 below:

"General Decision Number: IA20250046 03/14/2025

Superseded General Decision Number: IA20240046

State: Iowa

Construction Type: Building

County: Jasper County in Iowa.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(1).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	Executive Order 14026 generally applies to the contract. The contractor must pay all covered workers at least \$17.75 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2025.
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If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	Executive Order 13658 generally applies to the contract. The contractor must pay all covered workers at least \$13.30 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all
---	---

	hours spent performing on	
	that contract in 2025.	

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at <http://www.dol.gov/whd/govcontracts>.

Modification Number	Publication Date
0	01/03/2025
1	01/31/2025
2	02/07/2025
3	03/14/2025

BOIL0083-009 01/01/2025

	Rates	Fringes
BOILERMAKER.....	\$ 48.48	33.91

CARP0004-002 05/01/2024

	Rates	Fringes
CARPENTER (Form Work Only).....	\$ 33.50	28.42

* ELEV0033-002 01/01/2025

	Rates	Fringes
ELEVATOR MECHANIC.....	\$ 56.30	38.435+a+b

FOOTNOTES:

A. Employer contributes 8% of regular basic hourly rate as vacation pay credit for employees with more than 5 years of service, and 6% for employees with less than 5 years of service.

B. PAID HOLIDAYS: New Year's Day; Memorial Day; Independence Day; Labor Day; Veteran's Day; Thanksgiving Day; Day after Thanksgiving; & Christmas Day.

ENGI0234-004 05/01/2024

Rates	Fringes
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POWER EQUIPMENT OPERATOR

Crane.....	\$ 35.93	20.75
Class 1		
Forklift (On steel erection and machinery moving or hoisting above one complete story).....	\$ 34.10	20.75
Class 2		
Forklift (Other than the above).....	\$ 33.80	20.75

IRON0111-002 07/01/2024

	Rates	Fringes
IRONWORKER (Reinforcing).....	\$ 37.50	30.99

IRON0577-001 06/01/2024

	Rates	Fringes
IRONWORKER (Ornamental).....	\$ 34.05	25.30

LABO0177-002 05/01/2024

	Rates	Fringes
LABORER (Mason Tender - Brick)...	\$ 28.61	16.80

PAIN0246-001 05/01/2024

	Rates	Fringes
PAINTER (Brush and Roller).....	\$ 30.98	15.58

PAIN0676-001 05/01/2024

	Rates	Fringes
DRYWALL FINISHER/TAPER.....	\$ 31.82	19.05

PLUM0033-003 06/01/2024

	Rates	Fringes
PIPEFITTER (Includes HVAC Pipe and Unit Installation).....	\$ 43.20	23.25

SFIA0669-002 01/01/2025

	Rates	Fringes
SPRINKLER FITTER (Fire Sprinklers).....	\$ 43.04	26.06

SHEE0091-012 06/01/2024

	Rates	Fringes
SHEET METAL WORKER (Includes HVAC Duct Installation).....	\$ 37.12	22.22

* UAVG-IA-0001 01/01/2025

	Rates	Fringes
MILLWRIGHT.....	\$ 35.93	28.05

* SUIA2016-019 07/19/2016

	Rates	Fringes
BRICKLAYER.....	\$ 25.93	9.70
CARPENTER, Includes Acoustical Ceiling Installation, and Drywall Hanging (Excludes Form Work).....	\$ 23.25	12.22
CEMENT MASON/CONCRETE FINISHER...	\$ 21.12	11.07
ELECTRICIAN, Includes Installation of HVAC/Temperature Controls.....	\$ 23.58	9.15
INSULATOR: Mechanical (Duct, Pipe and Mechanical System Insulation).....	\$ 19.04	7.32
IRONWORKER, STRUCTURAL.....	\$ 25.29	15.89
LABORER: Common or General.....	\$ 17.25 **	6.93
LABORER: Landscape.....	\$ 14.81 **	0.00
LABORER: Pipelayer.....	\$ 18.00	2.70
OPERATOR: Backhoe/Excavator/Trackhoe.....	\$ 27.31	15.35
OPERATOR: Bobcat/Skid Steer/Skid Loader.....	\$ 27.55	22.85
OPERATOR: Bulldozer.....	\$ 22.31	8.36
OPERATOR: Loader.....	\$ 25.80	17.19
PLUMBER.....	\$ 31.85	15.12
ROOFER.....	\$ 14.00 **	3.91

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 (\$17.75) or 13658 (\$13.30). Please see the Note at the top of the wage determination for more information. Please also note that the minimum wage requirements of Executive Order 14026 are not currently being enforced as to any contract or subcontract to which the states of Texas, Louisiana, or Mississippi, including their agencies, are a party.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://www.dol.gov/agencies/whd/government-contracts>.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (iii)).

The body of each wage determination lists the classifications and wage rates that have been found to be prevailing for the type(s) of construction and geographic area covered by the wage determination. The classifications are listed in alphabetical order under rate identifiers indicating whether the particular rate is a union rate (current union negotiated rate), a survey rate, a weighted union average rate, a state adopted rate, or a supplemental classification rate.

Union Rate Identifiers

A four-letter identifier beginning with characters other than ""SU"", ""UAVG"", ?SA?, or ?SC? denotes that a union rate was prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2024. PLUM is an identifier of the union

whose collectively bargained rate prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. The date, 07/01/2024 in the example, is the effective date of the most current negotiated rate.

Union prevailing wage rates are updated to reflect all changes over time that are reported to WHD in the rates in the collective bargaining agreement (CBA) governing the classification.

Union Average Rate Identifiers

The UAVG identifier indicates that no single rate prevailed for those classifications, but that 100% of the data reported for the classifications reflected union rates. EXAMPLE: UAVG-OH-0010 01/01/2024. UAVG indicates that the rate is a weighted union average rate. OH indicates the State of Ohio. The next number, 0010 in the example, is an internal number used in producing the wage determination. The date, 01/01/2024 in the example, indicates the date the wage determination was updated to reflect the most current union average rate.

A UAVG rate will be updated once a year, usually in January, to reflect a weighted average of the current rates in the collective bargaining agreements on which the rate is based.

Survey Rate Identifiers

The ""SU"" identifier indicates that either a single non-union rate prevailed (as defined in 29 CFR 1.2) for this classification in the survey or that the rate was derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As a weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SUFL2022-007 6/27/2024. SU indicates the rate is a single non-union prevailing rate or a weighted average of survey data for that classification. FL indicates the State of Florida. 2022 is the year of the survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 6/27/2024 in the example, indicates the survey completion date for the classifications and rates under that identifier.

?SU? wage rates typically remain in effect until a new survey is conducted. However, the Wage and Hour Division (WHD) has the discretion to update such rates under 29 CFR 1.6(c)(1).

State Adopted Rate Identifiers

The ""SA"" identifier indicates that the classifications and prevailing wage rates set by a state (or local) government were

adopted under 29 C.F.R 1.3(g)-(h). Example: SAME2023-007 01/03/2024. SA reflects that the rates are state adopted. ME refers to the State of Maine. 2023 is the year during which the state completed the survey on which the listed classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 01/03/2024 in the example, reflects the date on which the classifications and rates under the ?SA? identifier took effect under state law in the state from which the rates were adopted.

WAGE DETERMINATION APPEALS PROCESS

1) Has there been an initial decision in the matter? This can be:

- a) a survey underlying a wage determination
- b) an existing published wage determination
- c) an initial WHD letter setting forth a position on a wage determination matter
- d) an initial conformance (additional classification and rate) determination

On survey related matters, initial contact, including requests for summaries of surveys, should be directed to the WHD Branch of Wage Surveys. Requests can be submitted via email to davisbaconinfo@dol.gov or by mail to:

Branch of Wage Surveys
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

Regarding any other wage determination matter such as conformance decisions, requests for initial decisions should be directed to the WHD Branch of Construction Wage Determinations. Requests can be submitted via email to BCWD-Office@dol.gov or by mail to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2) If an initial decision has been issued, then any interested party (those affected by the action) that disagrees with the decision can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Requests for review and reconsideration can be submitted via email to dba.reconsideration@dol.gov or by mail to:

Wage and Hour Administrator

U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210.

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END OF GENERAL DECISION"

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

SECTION 00 7500 – GENERAL CONDITIONS

1.1 GENERAL CONDITIONS

- A. AIA Document A201 – General Conditions of the Contract for Construction (2017 Edition), is the General Conditions between the Owner and the Contractor and is available for viewing at the office of the Architect.

1.2 SUPPLEMENTARY CONDITIONS

- A. Refer to Document 00 8000 for amendments to these General Conditions.

END OF SECTION 00 7500

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

SECTION 00 8000 – SUPPLEMENTARY CONDITIONS

The following supplements modify the "General Conditions of the Contract for Construction, "AIA Document A201, 2017 Edition. Where a portion of the General Conditions is modified or deleted by these Supplementary Conditions, the unaltered portions of the General Conditions shall remain in effect unless exceeded in requirements designated elsewhere in the Bid Documents.

ARTICLE 1 GENERAL PROVISIONS

1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

Add the following subparagraphs 1.2.4 and 1.2.5 to 1.2:

1.2.4 In the event of conflicts or discrepancies among the Contract Documents, interpretations will be based on the following priorities:

1. The Agreement.
2. Addenda, with those of later date having precedence over those of earlier date.
3. The Supplementary Conditions.
4. The General Conditions of the Contract for Construction.
5. Drawings and Specifications.

1.2.5 In the case of an inconsistency between Drawings, Specifications, and/or Addendum, or within any of the Documents, and not addressed and fully clarified by an Addendum, the better quality, greater quantity, or more stringent requirement of Work shall be provided in accordance with the Architect's interpretation. Should there be any discrepancy between the figures on the Drawings and the designated scale, the figures shall govern; large scale details and Drawings shall take precedence over smaller scale details and Drawings; and the printed specifications shall take precedence over notes on the Drawings but, in any case of discrepancy, the facts are to be brought to the attention of the Architect for a decision or interpretation.

1.2.6 In any case of discrepancy, the facts are to be brought to the attention of the Architect for a decision or interpretation. Prior to the Architect making a determination, it shall be assumed that the better quality, greater quantity, or more stringent requirement of Work shall be provided.

ARTICLE 2 OWNER (NO MODIFICATION OR CHANGE)

ARTICLE 3 CONTRACTOR

3.1 GENERAL

Add the following subparagraph 3.1.2.1 to 3.1.2:

3.1.2.1 The Contractor shall supervise and direct the Work in an excellent and workmanlike manner, complete the work and everything properly incidental thereto as stated in the Project Manual and Drawings or reasonably implied therefrom and otherwise in accordance with Contract Documents.

Add the following sentence to 3.2.1:

3.2.1 In no case shall the Contractor proceed with any portion of the work in any uncertainty.

3.3 SUPERVISION AND CONSTRUCTION PROCEDURE

Add the following subparagraph 3.3.4 to 3.3:

- 3.3.4 The Contractor acknowledges that it is the Contractor's responsibility to hire all personnel for the proper and diligent prosecution of the work and the Contractor shall use its best efforts to maintain labor peace for the duration of the Project. In the event of a labor dispute, the Contractor shall not be entitled to any increase in the Contract Sum.

3.4 LABOR AND MATERIALS

Add the following subparagraphs 3.4.4 and 3.4.5 to 3.4:

- 3.4.4 After the contract has been executed, the Architect, Owner, and Contractor shall function as a team to evaluate, review and consider substitution of products in place of those specified under the conditions set forth by the Architect.

- 3.4.5 By making requests for substitutions based on Subparagraph 3.4.2, the Contractor:
- .1 represents that the Contractor has personally investigated the proposed substitute product and determined that it is equivalent or superior in all respects to that specified;
 - .2 represents that the Contractor will provide the same warranty for the substitution that the Contractor would for that specified;
 - .3 certifies that the cost data presented is complete and includes all related costs under this Contract except the Architect's redesign costs, and waives all claims for additional costs related to the substitution which subsequently becomes apparent; and;
 - .4 will coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects.

3.7 PERMITS, FEES, NOTICES, AND COMPLIANCE WITH LAWS

- 3.7.4 Immediately after "Contractor", the first time it appears in the Subparagraph, insert ", any of its Subcontractors or any Subcontractor".
- 3.7.5 Immediately after "Contractor", the first time it appears in the Subparagraph, insert ", any of its Subcontractors or any Subcontractor".

3.9 SUPERINTENDENT

- 3.9.1 Supplement as follows: The approved Superintendent will work in this position until completion of the Work unless he shall no longer be in the Contractor's employ, or shall be released at the request of the Architect and/or Owner.

3.12 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

Add the following subparagraph 3.12.4.1 to 3.12.4:

- 3.12.4.1 Shop Drawings, Product Data, and Samples shall be identified as follows:

Name and address of Project: Colfax Economic Development Corporation –
Colfax Childcare Center–
20 West Broadway
Colfax, IA 50054

Architect: ATURA Architecture

Architects job number: 2025-055

Division and Section: of specification for which Drawing is submitted.

Contractor's name and date:

Subcontractor's name and date:

Contractor's Approval Stamp: Shop Drawings shall also bear the Contractor's stamped approval and note all required field dimensions.

3.14 CUTTING AND PATCHING

Add the following subparagraph 3.14.3 to 3.14

3.14.3 In addition to such cutting, fitting or patching that may be necessary to fit the several parts of this or other contractor's or subcontractor's work together, any cutting, fitting, or patching of work in place that may be required will be at the expense of the contractor concerned. Each contractor or subcontractor shall determine and be responsible for the proper location of and character of all inserts for hangers, holes, chases and other openings in the construction, and shall give the other interested contractors due and proper notification with regard to same. Any cutting, fitting, repairing, patching, etc., required whether it be of work in place of executing the initial installation must be done by craftsmen specially skilled in their respective trades.

ARTICLE 4 ADMINISTRATION OF THE CONTRACT (NO MODIFICATION OR CHANGE)

ARTICLE 5 SUBCONTRACTORS (NO MODIFICATION OR CHANGE)

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS (NO MODIFICATION OR CHANGE)

ARTICLE 7 CHANGES IN THE WORK

Add the following sentence to subparagraph 7.1.1:

7.1.1 No claim for an addition to the maximum Contract sum shall be considered a valid claim unless a written change order procedure is followed as outlined in this Article. Verbal authorization for changes must be supported by written approval before being considered valid.

Add the following subparagraph 7.1.3.1 to 7.1.3:

7.1.3.1 Verify correctness of all measurements at building before ordering materials or doing Work. Notify Architect of any discrepancies before proceeding. No extra compensation allowed for difference between actual measurements and plan dimensions.

Add the following subparagraph 7.1.4:

7.1.4 Changes in the work shall be approved by the owner prior to proceeding with the change in the work. Contractor's failure to do so may result in denial of the amount of the adjustment in the Contract Sum and the extent of the adjustment in the Contract Time.

7.2 CHANGE ORDERS

Add the following subparagraph 7.2.2 to 7.2:

7.2.2 The method used in determining adjustments to the Contract Sum shall be the method listed in Subparagraph 7.3.4. The Architect will decide which method is to be used.

7.3 CONSTRUCTION CHANGE DIRECTIVES

7.3.3 Add the following sentence:

The Architect shall decide on the method to be used.

7.3.4 Substitute the following subparagraphs:

- .1 For the Contractor and each Subcontractor and Sub-subcontractor involved; for Work performed by their own forces, labor shall be billed at their hourly rate (hourly rates shall be submitted at the beginning of the project), and materials shall be billed at actual cost plus 10 percent.
- .2 For the Contractor, for Work performed by the Contractor's Subcontractor, the Contractor may bill up to 10 percent of the amount due the Subcontractor.
- .3 Rental costs of machinery and equipment, exclusive of hand tools, rented from sources other than the Contractor, actual amount that is due the rental source.
- .4 Cost of machinery and equipment provided by the Contractor, Subcontractors, or Sub-subcontractors, exclusive of hand tools, actual hourly rate costs.
- .5 Costs of bonds, insurance, estimating, office administration (including the contractor's project manager), and similar work is considered a part of the overhead and profit mark-up, and is not a separate billable item.

In order to facilitate checking of quotations for extras or credits, all proposals, except those so minor that their propriety can be seen by inspection, shall be accompanied by a complete itemization of costs including: labor, materials, Subcontracts, Sub-subcontracts, machinery and equipment rental, and permit fees. The costs shall be billed in the manner prescribed above. Where major cost items are Subcontracts, or Sub-subcontracts, they shall be itemized in a like manner. At the request of the Architect or Owner, material invoices, validation cost itemization, shall be provided by the Contractor, Subcontractors, and Sub-subcontractors.

ARTICLE 8

TIME

(NO MODIFICATION OR CHANGE).

ARTICLE 9

PAYMENTS AND COMPLETION

9.3 APPLICATIONS FOR PAYMENT

Add the following sentence to Subparagraph 9.3.1:

- 9.3.1 The form of Application for Payment shall be a notarized AIA Document G702 Application and Certification for Payment, and supported by AIA Document G703 Continuation Sheet (or similar forms approved by the Architect).

Add the following Clause 9.3.1.3 to 9.3.1:

- 9.3.1.3 Retainage: The Owner shall pay 95% of the amount due the Contractor on account of progress payments. The Owner will retain the remaining 5% of the progress payments as retainage. The retainage will be paid the Contractor upon completion and acceptance of the project by the Owner, including all required paperwork.

9.10 FINAL COMPLETION AND FINAL PAYMENT

Add the following subparagraphs 9.10.2.1 and 9.10.2.2 to 9.10.2:

- 9.10.2.1 The Contractor shall provide the following documents listed under the applicable project category:

Final application for payment will not be approved for payment by the Architect until the following list of documents are provided to the Owner by the Contractor in a close-out document, in a form acceptable to the owner, consisting of, but not limited to:

1. **Operations and Maintenance Manuals.**
2. **Completed maintenance status sheet.**
3. **Warranties.**
4. **HVAC system start-up report.**

5. Executed original occupancy permit.
6. Record Drawings of the building, utilities, site, and appurtenances.
7. Contractor's Affidavit of Payments of Debts and Claims (use AIA Form G706).
8. Contractor's Affidavit that lien waivers submitted represent all labor and materials for which a lien can be filed (use AIA Form G706A).
9. Consent of Surety to final payment (use AIA Form G707).
10. Asbestos-free Materials Certification from the General, Mechanical, and Electrical Contractors.

9.10.2.2 The Contractor shall provide Project Record Documents, Operation and Maintenance Manuals, Instruction of Owner's personnel, Final Cleaning and other closeout procedures specified elsewhere.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

10.2 SAFETY OF PERSONS AND PROPERTY

Add the following subparagraph 10.2.5.1 to 10.2.5:

10.2.5.1 Until final acceptance of the Work, as evidenced in writing, the Contractor shall have charge and care thereof and shall replace, at his own expense, any materials lost or not otherwise protected by the Owner's Property Insurance as called for in Article 11 of the General Conditions.

ARTICLE 11 INSURANCE AND BONDS

Add the following Clauses 11.1.1.1 through 11.1.1.3 to 11.1.1:

11.1.1.1 The insurance required by Subparagraph 11.1.1 shall be written for not less than the following limits, or greater if required by law and shall be maintained by insurance carriers acceptable to Owner and Owner's lender:

1. **Worker's Compensation:**

(a) State:	Statutory
(b) Employer's Liability	\$1,000,000 per Accident \$1,000,000 Disease Policy Limit

2. **Comprehensive or Commercial General Liability (including Premises-Operations; Independent Contractors Protective; Products and Completed Operations; Broad Form Property Damage):**

(a) Bodily Injury:	
\$2,000,000	Each Occurrence
\$2,000,000	Aggregate
(b) Property Damage:	
\$1,000,000	Each Occurrence
\$1,000,000	Aggregate
(c) Products and Completed Operations to be maintained for one year after final payment:	
\$500,000	Aggregate
(d) Property Damage Liability Insurance shall provide X, C and U coverage.	

- (e) **Broad Form Property Damage Coverage shall include Completed Operations.**
3. **Contractual Liability:**
- (a) **Bodily Injury:**
\$2,000,000 **Each Occurrence**
\$2,000,000 **Aggregate**
- (b) **Property Damage:**
\$500,000 **Each Occurrence**
\$500,000 **Aggregate**
4. **Personal injury, with Employment Exclusion deleted:**
\$1,000,000 **Aggregate**
5. **Business Auto Liability (including owned, non-owned and hired vehicles):**
- (a) **Bodily Injury:**
\$1,000,000 **Each Person**
\$1,000,000 **Each Occurrence**
- (b) **Property Damage:**
\$1,000,000 **Aggregate**
- (c) **Liability insurance may be arranged by Comprehensive General Liability and Comprehensive Automobile Liability policies for the full limits required or by a combination of underlying comprehensive policies for lesser limits with the remaining limits provided by an Excess or Umbrella Liability policy.**
7. **Umbrella Excess Liability:**
\$1,000,000 **Over primary insurance**
\$10,000 **Retention for self-insured hazards each occurrence**
- 11.1.1.2 If the insurance is written on the Comprehensive General Liability policy form, the Certificates shall be AIA Document G715, Certificate of Insurance. If this insurance is written on a Commercial General Liability policy form, ACORD form 25S will be acceptable. The Contractor shall furnish to the Owner copies of any endorsements that are subsequently issued amending coverage or limits. Special note shall be made on the certificate indicating that to the fullest extent permitted by law and subject to conditions, limitations and exclusions identified in Paragraph 3.18 – Indemnification, coverage will protect, indemnify, and hold harmless the Owner from and against claims and liabilities for injury to or death of persons or damage to property caused or alleged to have been caused by negligent acts or omissions of the principal Contractor or of his subcontractors, including the direct or indirect agents and employees of the principal Contractor and his subcontractors and arising from operations under this Contract.
- 11.1.1.3 Certificates of Insurance acceptable to the Owner shall be filed with the Owner prior to the execution of the Contract.

ARTICLE 12
UNCOVERING AND CORRECTION OF WORK
(NO MODIFICATION OR CHANGE)

ARTICLE 13
MISCELLANEOUS PROVISIONS
(NO MODIFICATION OR CHANGE)

ARTICLE 14
TERMINATION OR SUSPENSION OF THE CONTRACT
(NO MODIFICATION OR CHANGE)

END OF SECTION 00 8000

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 01 1000 – SUMMARY OF WORK

1. GENERAL

1.1 SUMMARY

- A. Project Description: The Work of this project shall consist of single construction contract.**
1. Description of Work: The work of this project includes the following:
 - a. General Construction.
 - b. Site Construction, including: Grading, Concrete Paving, and Site Utilities.
 - c. Mechanical Construction, including: Plumbing, Heating, Ventilating, and Air Conditioning.
 - d. Electrical Construction, including: Power, Lighting, Communication, and Fire Safety.
 2. The Contractor shall include all parts and labor necessary to provide a complete structure ready for use by the Owner.
- B.** The General Contractor shall be identified as the Contractor and shall have control of the site and coordinate all operations within their Contract and shall classify and allocate materials and labor to the various trades in accordance with local customs, jurisdiction, etc. The Owner shall not occupy space prior to final acceptance without approval and scheduled time with the Contractor.
- C.** The General Contractor shall coordinate the project and keep all subcontractors apprised at all times of his construction schedule submitted and updated regularly in a format representing each Division and major section of Work.

1.2 REGULATORY REQUIREMENTS

- A.** The following regulations are applicable to this project:
1. Iowa State Building Code.
 2. International Building Code – 2015 Edition.
 3. International Fire Code – 2015 Edition.
 4. International Energy Conservation Code – 2012 Edition.
 5. 2010 Americans with Disabilities Act Standards.
 6. International Mechanical Code – 2021 Edition, and Iowa Administrative Code 641-61.
 7. Uniform Plumbing Code – 2021 Edition, and Iowa Administrative Code 641-25.
 8. National Electrical Code – 2020 Edition, and Iowa Administrative Code 661-504.

1.3 HAZARDOUS MATERIALS EXCLUSION

- A.** If, during execution of the Work, the need for removal or encapsulation of asbestos or other hazardous materials as defined under State or Federal laws are encountered or suspected, the Contractor shall immediately cease work in the area of such materials and notify Owner and Architect, in writing. No claim for delay, resulting from the Contractor's failure to promptly notify Owner, will be honored. The Owner is responsible for removal procedures concerning all such hazardous materials discovered during the Work of this Contract.

1.4 ACCESS TO THE SITE AND USE OF THE PREMISES

- A.** Work Area: Access to site shall be coordinated with the Owner. Construction staging and storage shall be maintained within the Limits of Construction as defined by the Owner and as indicated on the Drawings, except as provided below:
1. Adjoining public sidewalks and roadways may be used as permitted by the applicable governing authorities. The cost, if any, shall be an obligation of the Contractor.

2. Disturbed public areas shall be put back into their original state at completion of use, as approved by the authorities having jurisdiction.
 3. Restrictions on the work imposed by such authority having jurisdiction, including restrictions on the use of streets, shall not constitute the basis for extra payment to the Contractor, nor extension of time for completion of the Contract.
- B. Utilities: Verify location of all utilities on site with Utility Companies and Owner. Send notices, make necessary arrangements and perform other services required in care and maintenance of existing utilities. Assume responsibility for which Owner may be liable. Provide enclosing or boxing-in, removal or relocation as necessary for protection of existing utilities equipment. Upon completion of work involved in execution of the Contract, remove all enclosures, fill in all openings and concrete, grout watertight and leave in finished condition.
- C. Unless otherwise indicated or specified, all water, gas, irrigation lines, lighting, power and telephone conduits and wires, sewer lines, connections in place and other surface or subsurface structure and lines and landscaping except as specifically indicated to be removed shall be maintained by each Contractor and shall not be disturbed, disconnected or damaged during the progress of work.
- D. Notify the Architect immediately upon discovery of any utility lines not shown on plans which interfere with construction.
- E. Should the Contractor in performance of work disturb, disconnect or damage any of the above, all expenses arising from disturbances or in replacing or repair shall be borne by the Contractor.

1.7 SIGNS

- A. Architectural Firm Sign: As a part of the Contract, the General Contractor shall hang an Architectural Firm Sign, provided by the Architect.
- B. The Architectural Firm Sign shall be returned to the Architect, undamaged, for reuse, at the completion of the project.

END OF SECTION 01 1000

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 01 2000 – PRICE AND PAYMENT PROCEDURES

1. GENERAL

1.1 SUMMARY

- A. This Section includes the responsibilities and procedures involved with Allowances, Unit Prices and Alternates. This information is provided for general use during the course of the project and does not necessarily mean that Allowances or Alternates exist at the time of the Bid. Refer to individual Specification Sections or the Drawings for the identification of Allowances or Alternates specific to the Work of this project.
- B. The Contractor shall include in his Bid, all Allowance costs in the manner identified in Article 3.8 of the General Conditions.

1.2 ALLOWANCES

- A. Allowances may include any or all of the following:
 - 1. Lump sum allowances.
 - 2. Unit cost allowances.
 - 3. Contingency allowances.
 - 4. Testing and inspecting allowance.
 - 5. Quantity allowances.
- B. Costs Included in Allowances: Cost of Product to Contractor or Subcontractor, less applicable trade discounts; and applicable taxes.
- C. Costs Not Included in the Allowance But Included in Contract Sum: Protection of products from elements and from damage; and labor for installation and finishing, overhead, profit, and other expenses contemplated for stated allowance amounts.
- D. Architect Responsibilities:
 - 1. Select products in consultation with Owner and transmit decision to Contractor.
 - 2. Prepare Change Order.
- E. Contractor Responsibilities:
 - 1. On notification of selection by Architect, Owner, execute purchase agreement with designated supplier and installer.
 - 2. Arrange for and process shop drawings, product data, and samples. Arrange for delivery.
 - 3. Promptly inspect products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.
- F. Difference in costs will be adjusted by Change Order.
- G. Selection and Purchase:
 - 1. At the earliest practical date after award of the Contract, advise Architect of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
 - 2. Purchase products and systems selected by Architect from the designated supplier.
- H. Submittals:
 - 1. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

2. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

1.3 UNIT PRICES

- A. Refer to Article 7.3 of the General Conditions for application of Unit Prices.
- B. Definition:
 1. Unit price is an amount proposed by bidders, stated on the Bid Form, as a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased.
- C. Procedures:
 1. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
 2. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
 3. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
 4. Schedule of Unit Costs: A list of unit prices is included at the end of this Section. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.
 5. Where a specified quantity of work/allowance is included in the Base Bid, and is furnished and installed at a Unit Price, the actual furnished and installed quantity of work shall be measured, and any difference shall be adjusted by a change order. The actual furnished and installed quantity of work in excess of the specified quantity of work/allowance shall constitute an addition to the Contract at the Unit Price. The actual furnished and installed quantity of work less than the specified quantity of work/allowance shall constitute a deduction to the Contract at the Unit Price.

1.4 ALTERNATES

- A. Related Documents:
 1. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 01 Specification sections, apply to work of this section.
 2. Description Of Requirements:
 - a. Definition: An Alternate is an amount shown in the Form of Proposal that will be added or deducted from the Contract Amount if the Owner elects to accept the Alternate by issuance of a Change Order in the stated amount altering in either scope of work or in products, materials, equipment, systems or installation requirements methods described in the Contract Documents.
 - 1) The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.
 - b. Coordination: Contractor to coordinate related work and modify and adjust adjacent work as required to ensure that work affected by each accepted Alternate is complete and fully integrated into the Project.
 - 1) Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
 - c. Notification: Immediately after Contract Signing prepare and distribute to each party involved a notification of the status regarding each Alternate. Indicate whether Alternates

- have been accepted, rejected, or deferred for consideration at a later date. Include a complete description of negotiated modifications to Alternates, if any.
- d. Execute accepted alternates under the same conditions as other work of the Contract.
- e. Schedule: A Schedule of Alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

1.5 SCHEDULE OF VALUES

- A. Submit the Schedule of Values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Sub-schedules: Where the Work is separated into phases requiring separately phased payments, provide sub-schedules showing values correlated with each phase of payment.
- C. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the Schedule of Values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value.
 - 1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 - 3. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. Include evidence of insurance or bonded warehousing if required.
 - 4. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.

1.6 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement. Payments will be made within thirty (30) days of Contractor's Application for Payment submittal.

- C. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets, or similar forms approved by the Architect, as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 - 1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
 - 2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Transmittal: Submit electronically, a signed and notarized copy of each Application for Payment to Architect. Include waivers of lien and similar attachments if required.
- F. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 - 1. List of subcontractors.
 - 2. Schedule of Values.
 - 3. Contractor's Construction Schedule (preliminary if not final).
 - 4. Products list.
 - 5. Copies of building permits.
 - 6. Certificates of insurance and insurance policies.
 - 7. Performance and payment bonds.
- G. Retainage: The Owner shall pay 95% of the amount due the Contractor on account of progress payments. The Owner will retain the remaining 5% of the progress payments as retainage. The retainage will be paid the Contractor upon completion and acceptance of the project by the Owner, including all required paperwork.
- H. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
 - 1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
- I. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following (refer also to Section 01 7700 – Closeout Procedures):
 - 1. Evidence of completion of Project closeout requirements.
 - 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 - 3. Updated final statement, accounting for final changes to the Contract Sum.
 - 4. AIA Document G706, "Contractor's Affidavit of Payment of Debs and; Claims."
 - 5. AIA Document G707, "Consent of Surety to Final Payment."
 - 6. Evidence that claims have been settled.

2. PRODUCTS (not used)

3. EXECUTION

3.1 SCHEDULE OF ALLOWANCES

- A. NOT USED.

3.2 SCHEDULE OF ALTERNATES

- A. ALTERNATE NO. 1 – State the amount to be ADDED to the Base Bid to furnish and install the landscaping wall.

3.3 SCHEDULE OF UNIT PRICES

- A. UNIT PRICE NO. 1 – State the amount to be ADDED to the Base Bid for each additional cubic yard of over-excavation, controlled engineered fill, and compaction in the area of deficient soil load bearing capacity. The amount of over-excavation, controlled engineered fill, and compaction shall be determined by measuring the width, length, and depth of the excavation; and shall be verified by the Architect.

END OF SECTION 01 2000

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 01 3000 – ADMINISTRATIVE REQUIREMENTS

1. GENERAL

1.1 COORDINATION AND MEETINGS

- A. Pre-construction Meeting:
 - 1. Prepare for and attend an initial meeting before date of commencement of Work. Time, place, agenda, and leader of meeting will be determined by Architect.
 - 2. The following shall attend:
 - a. Owner's Representative.
 - b. Architect and Consultants.
 - c. Contractor's Project Manager.
 - d. Contractor's Superintendent.
 - e. Major subcontractors.
- B. Progress Meetings:
 - 1. Progress meetings shall be held on bi-weekly basis at regularly scheduled times that are convenient for the attendance of subcontractors and other parties involved.
 - 2. The following list of construction representatives shall attend all scheduled construction progress meetings:
 - a. Owner
 - b. Architect
 - c. Project Superintendent of the following:
 - 1) General Contractor.
 - 2) Mechanical Subcontractor.
 - 3) Electrical Subcontractor.
 - d. Other subcontractors and suppliers as requested by the General Contractor or Architect.
 - 3. Responsibilities:
 - a. Architect: Cooperate in scheduling and attending all regularly scheduled Project Meetings. Notify General Contractor prior to meeting if representative is unable to attend.
 - b. General Contractor: Shall preside at each meeting, prepare an agenda, and record meeting results, and distribute meeting minutes to everyone in attendance and to others affected by the decisions and actions resulting from each meeting.
 - c. Major Subcontractors: Cooperate in scheduling and attending all regularly scheduled Project Meetings. Notify General Contractor prior to meeting if representative is unable to attend.
- C. Pre-Installation Meetings:
 - 1. Hold pre-installation meeting before each of the following activities commence as indicated in specifications.
 - 2. Time, place, agenda, and list of persons to be present will be determined by Contractor. Generally, the installers of all parts of the assembly shall be present, together with producers of critical items.
- D. Cross Discipline Coordination:
 - 1. General:
 - a. General Contractors: Review all Contract Drawings and Specifications to ascertain all items of work which may indicate materials or labor to be supplied by several subcontractors.
 - b. General Contractors: Verify that cross discipline work as indicated below has been included in proposals even though this requirement has not been specifically cross referenced by the Contract Documents.

1.2 CONSTRUCTION PROGRESS DOCUMENTATION

- A. Color Schedule:
 - 1. After the Contractor has submitted and received approval of all subcontractors and materials from Architect he shall provide Architect with current color samples of all items where color selection is required.
 - 2. The Architect will prepare a Color Schedule of the Project and submit to the Contractor after securing the Owner's approval.
- B. Progress Schedules and Reports:
 - 1. The Contractor shall submit with the Application for Payment a progress schedule noting work complete, product delivery schedule and current status of project.

1.3 SUBMITTAL PROCEDURES

- A. Summary:
 - 1. Shop drawing and product data submittals shall be transmitted to the Architect / Engineer in electronic (PDF) format using a website service designed specifically for transmitting submittals, RFI's, and other documents between construction team members.
 - a. Approved website service companies are Procore, Fieldwire, or approved equal. Contractors wanting to use another website service other than listed, shall have prior approval from the Architect during the bidding process.
 - b. Website service companies shall have an app available for use via a tablet where all project documents are consistently updated and available for viewing.
 - 2. The intent of electronic submittals is to expedite the construction process by reducing paperwork, improving information flow, and decreasing turnaround time.
 - 3. The electronic submittal process is not intended for color samples, color charts, or physical material samples.
- B. Procedures:
 - 1. Submittal Preparation – Contractor may use any or all of the following options:
 - a. Subcontractors and Suppliers provide electronic (PDF) submittals to Contractor via the website.
 - b. Subcontractors and Suppliers provide electronic submittals to General Contractor who then submits them via the website.
 - c. Subcontractors and Suppliers provide paper submittals to General Contractor who electronically scans and converts to PDF format, then submits them via the website.
 - 2. Contractor shall review and apply electronic stamp certifying that the submittal complies with the requirements of the Contract Documents including verification of manufacturer / product, dimensions and coordination of information with other parts of the work.
 - 3. Architect / Engineer review comments will be made available on the website for downloading. Contractor will receive email notice of completed review.
 - 4. Distribution of reviewed submittals to subcontractors and suppliers is the responsibility of the Contractor.
 - 5. Submit paper copies of reviewed submittals at project closeout for record purposes in accordance with Section 01 77 00 – Closeout Submittals
- C. Costs:
 - 1. General Contractor shall include the full cost of the website service subscription in their proposal. This cost shall be included in the Contract Amount.

END OF SECTION 01 3000

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 01 3300 – SUBMITTAL REQUIREMENTS

1. GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Submittal Procedures.
 - 2. Construction Progress Schedules.
 - 3. Proposed products list.
 - 4. Product data
 - 5. Shop drawings
 - 6. Samples
 - 7. Design data
 - 8. Test Reports
 - 9. Certificates
 - 10. Manufacturer's instruction
 - 11. Manufacturer's field reports
 - 12. Erection drawings
 - 13. Construction photographs

1.2 SUBMITTAL DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Architect's and Construction Manager's responsive action.
- B. Informational Submittals: Written information that does not require Architect's and Construction Manager's approval. Submittals may be rejected for not complying with requirements.

1.3 SUBMITTAL PROCEDURES

- A. Summary:
 - 1. Shop drawing and product data submittals shall be transmitted to the Architect / Engineer in electronic (PDF) format using a website service designed specifically for transmitting submittals, RFI's, and other documents between construction team members.
 - a. Approved website service companies are Procore, Fieldwire, or approved equal. Contractors wanting to use another website service other than listed, shall have prior approval from the Architect during the bidding process.
 - b. Website service companies shall have an app available for use via a tablet where all project documents are consistently updated and available for viewing.
 - 2. The intent of electronic submittals is to expedite the construction process by reducing paperwork, improving information flow, and decreasing turnaround time.
 - 3. The electronic submittal process is not intended for color samples, color charts, or physical material samples.
 - 4. All color selections shall be approved via review of the shop drawings and product data submittals. Color selections are only final when the associated submittal has been reviewed and approved by the Architect.
- B. Procedures:
 - 1. Submittal Preparation – Contractor may use any or all of the following options:
 - a. Subcontractors and Suppliers provide electronic (PDF) submittals to Contractor via the website.

- b. Subcontractors and Suppliers provide electronic submittals to General Contractor who then submits them via the website.
 - c. Subcontractors and Suppliers provide paper submittals to General Contractor who electronically scans and converts to PDF format, then submits them via the website.
 - 2. Contractor shall review and apply contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents.
 - 3. Architect / Engineer review comments will be made available on the website for downloading. Contractor will receive email notice of completed review.
 - 4. Allow space on submittals for Contractor and Architect/Engineer review stamps.
 - 5. When revised for resubmission, identify changes made since previous submission.
 - 6. Submittals not requested will not be recognized or processed.
 - 7. Deviations: Highlight, encircle, or otherwise identify deviations from the Contract Documents on submittals.
 - 8. Distribution of reviewed submittals to subcontractors and suppliers is the responsibility of the Contractor.
 - 9. Use for Construction: Use only final submittals with mark indicating action taken by Architect and Contractor.
 - 10. Submit paper copies of reviewed submittals at project closeout for record purposes in accordance with Section 01 77 00 – Closeout Submittals
- C. General: Electronic copies of CAD Drawings of the Contract Drawings may be provided by Architect for Contractor's use in preparing submittals. Prior to Contract Drawing usage, the Contractor is required to: obtain the Architect's written permission; obtain the Architect's waiver of liability; and pay the Architect a fee, the amount of which is established by the Architect.
- D. Architect/Engineer review is for general conformance with design concept and Contract Documents. Markings or comments shall not be construed as releasing Contractor from compliance with Contract Documents. Contractor is responsible for details and accuracy, for confirming and correlating quantities and dimensions, for selection of fabrication processes, for technique of assembly, and for performing work in a safe manner.
- E. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
- 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- F. Processing Time: Allow enough time for submittal review, including time for resubmits, as follows. Time for review shall commence on Architect's receipt of submittal.
- 1. Initial Review: Allow fifteen (15) days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals.
 - 2. If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 3. Allow ten (10) days for processing each re-submittal.
 - 4. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.

2. PRODUCTS

2.1 PROPOSED PRODUCTS LIST

- A. Within fifteen (15) days after date of Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

2.2 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections. Submit electronically, each submittal for the Architect's review.
 - 1. Color selections noted within submittals: Submittals shall not include color and/or pattern selections unless the product specifications list a specific color and/or pattern. If the submittal notes a color and/or pattern that is not specified, the color and/or pattern shall be verified with a notation specific to that color and/or pattern selection by the Architect. Any cost to change a color and/or not verified by the Architect, shall be the responsibility of the company that created the submittal.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
 - 2. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
 - 3. Mark each copy of each submittal to show which products and options are applicable. Supplement manufacturer's standard data to provide information specific to this Project.
 - 4. Include the following information, as applicable:
 - a. Manufacturer's written recommendations.
 - b. Manufacturer's product specifications.
 - c. Manufacturer's installation instructions.
 - d. Standard color charts.
 - e. Manufacturers catalog cuts.
 - f. Wiring diagrams showing factory-installed wiring.
 - g. Mill reports.
 - h. Standard product operating and maintenance manuals.
 - i. Compliance with recognized trade association standards.
 - j. Compliance with recognized testing agency standards.
 - k. Application of testing agency labels and seals.
 - l. Notation of coordination requirements.
 - m. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
 - 1. Preparation: Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products.
 - c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Schedules.
 - g. Design calculations when required by specification section.
 - h. Notation of coordination requirements.
 - i. Notation of dimensions established by field measurement.
 - j. Compliance with specified standards.
 - k. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
 - 2. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
 - 3. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8 ½ x 11 inches but no larger than 24 x 36 inches.

- D. Samples: Prepare physical units of materials or products, including the following:
 - 1. Comply with requirements in Section 01 4000 – Quality Requirements for mockups.
 - 2. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - 3. Submit Samples for review of kind, color, pattern, and texture for a final check of these characteristics with other elements and for a comparison of these characteristics between final submittal and actual component as delivered and installed.
 - a. Refer to individual Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.
 - 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 - 5. Include identification on each sample, with full Project information.
 - 6. Submit number of samples specified in individual specification sections; Architect will retain two samples.
 - 7. Reviewed samples which may be used in the Work are indicated in individual specification sections.
 - 8. Samples will not be used for testing purposes unless specifically stated in specification section.
- E. Delegated-Design Submittal: Comply with requirements in Section 01 4000 – Quality Requirements.

2.3 INFORMATIONAL SUBMITTALS

- A. General:
 - 1. Submit electronically.
 - 2. Test and Inspection Reports: Comply with requirements in Section 01 4000 – Quality Requirements.
 - 3. Prepare and submit Informational Submittals required by other Specification Sections. Certificates may include but are not limited to the following:
- B. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with specified requirements.
 - 1. Certificates may be recent or previous test results on material or Product, but must be acceptable to Architect/Engineer.
- C. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- D. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements and, where required, is authorized for this specific Project.
- E. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements in Section 01 7700 - Closeout Procedures.
- F. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load

diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

1. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

G. Manufacturer's Instructions

1. When specified in individual specification sections, submit printed instruction for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Architect/Engineer for delivery to Owner in quantities specified for Product Data.
2. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

H. Manufacturer's Field Reports

1. Submit reports for Architect/Engineer's benefit as contract administrator or for Owner.
2. Submit report in duplicate within fifteen (15) days of observation to Architect/Engineer for information.
3. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

I. Erection Drawings

1. Submit reports for Architect/Engineer's benefit as contract administrator or for Owner.
2. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.
3. Data indicating inappropriate or unacceptable Work may be subject to action by Architect/Engineer or Owner.

END OF SECTION 01 3300

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 01 4000 – QUALITY REQUIREMENTS

1. GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 REFERENCE STANDARDS

- A. This Specification identifies materials that are required to meet minimum standards when such standards are referred to by organization and number. The organizations include but are not limited to the following:
 - ASTM - American Society for Testing Materials
 - ASA - American Standards Association
 - AISC - American Institute of Steel Construction
 - ACI - American Concrete Institute
 - IDOT - Iowa Department of Transportation
 - AIA - American Institute of Architects
 - ANSI - American National Standards Institute
 - NFPA - National Fire Protection Association
 - UL - Underwriters' Laboratories, Inc.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full-size, physical example assemblies to illustrate finishes and materials. Mockups are used to verify selections made under Sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Mockups establish the standard by which the Work will be judged.
- D. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

1.4 DELEGATED DESIGN

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

1.5 QUALITY CONTROL SUBMITTALS

- A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.
- C. Reports: Prepare and submit certified written reports that include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.
 - 8. Complete test or inspection data.
 - 9. Test and inspection results and an interpretation of test results.
 - 10. Ambient conditions at time of sample taking and testing and inspecting.
 - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 - 12. Name and signature of laboratory inspector.
 - 13. Recommendations on retesting and reinspecting.
- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- C. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

- D. **Manufacturer Qualifications:** A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance.
- E. **Professional Engineer Qualifications:** A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.
- F. **Specialists:** Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 - 1. Requirement for specialists shall not supersede building codes and similar regulations governing the Work, nor interfere with local trade-union jurisdictional settlements and similar conventions.
- G. **Testing Agency Qualifications:** An agency with the experience and capability to conduct testing and inspecting indicated, as documented by ASTM E 548, and that specializes in types of tests and inspections to be performed.
- H. **Mockups:** Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
 - 2. Notify Architect seven (7) days in advance of dates and times when mockups will be constructed.
 - 3. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
 - 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 6. Demolish and remove mockups when directed, unless otherwise indicated.

1.7 QUALITY CONTROL

- A. **Contractor Responsibilities:** Unless otherwise indicated, provide quality-control services specified and required by authorities having jurisdiction.
 - 1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - 2. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 - 3. Notify Special Inspections Testing Agency of construction progress and schedule inspection forty-eight (48) hours minimum prior to work.
 - 4. Provide Special Inspections Agency with a schedule (activities and dates) of special inspections.
- B. **Special Tests and Inspections:** Owner will engage a testing agency to conduct special tests and inspections required by the International Building Code 2015, Chapter 17.
- C. **Special Inspections & Testing Schedule:** Special Inspections and Testing shall comply with the applicable Sections of Chapter 17 of the IBC 2015, as follows:
 - Concrete Construction (1705.3)
 - 1. Inspection of reinforcing steel placement.
 - 2. Inspection of reinforcing bar welding.
 - 3. Inspection of anchors cast in concrete.
 - 4. Inspection of anchors post-installed in hardened concrete.

5. Verify use of required design mix.
6. Prior to concrete placement, fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete.
7. Inspect concrete and shotcrete placement for proper application techniques.
8. Verify maintenance of specified curing temperature and techniques.
9. Inspection of formwork for shape, location, and dimensions of the concrete member being formed.

Soils (Table 1705.6)

1. Verify materials below footings are adequate to achieve the design bearing capacity.
 2. Verify excavations are extended to proper depth and have reached proper material.
 3. Perform classification and testing of controlled fill material.
 4. Verify use of proper materials, densities, and lift thicknesses during placement and compaction of controlled fill.
 5. Prior to placement of controlled fill, observe subgrade and verify that the site has been properly prepared.
- D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.
- E. Retesting/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction that revised or replaced Work that failed to comply with requirements established by the Contract Documents. Costs for retesting and re-inspecting the work will be the Contractor's responsibility.
- F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 3. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 4. Do not release, revoke, alter, or increase requirements of the Contract Documents or approve or accept any portion of the Work.
 5. Do not perform any duties of Contractor.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

2. PRODUCTS (Not Used)

3. EXECUTION

3.1 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Sections of these Specifications. Restore patched areas and extend restoration into adjoining areas in a manner that eliminates evidence of patching.

2. Comply with the Contract Document requirements for Section 01 7329 – Cutting and Patching.
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 4000

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 01 4200 – REFERENCES

1. GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Contractor": The term "Contractor" shall be used interchangeably with the words "Prime Contractor" and have the same meaning.
- C. "Approved": The term "approved," when used to convey Architect's action on Contractor's submittals, applications, and requests, is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- D. "Directed": Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean directed by Architect, requested by Architect, and similar phrases.
- E. "Indicated": The term "indicated" refers to graphic representations, notes, or schedules on Drawings or to other paragraphs or schedules in Specifications and similar requirements in the Contract Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the user locate the reference.
- F. "Regulations": The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- G. "Furnish": The term "furnish" means to supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- H. "Install": The term "install" describes operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- I. "Provide": The term "provide" means to furnish and install, complete and ready for the intended use.
- J. "Installer": An installer is the Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
- K. The term "experienced," when used with an entity, means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
 - 1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to trades people of the corresponding generic name.

- L. "Project site" is the space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.
- M. "Verify": The term "verify" is to check whether or not something is true by examination, investigation, or comparison. Such examination, investigation, or comparison shall take place prior to construction of the item to be verified. If the verification proves the item and/or dimension to not be true, the Contractor shall promptly notify the Architect. The Architect will then investigate the verified conditions and submit Supplemental Instructions outlining the action to be taken.

1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents, unless otherwise indicated.
- C. Conflicting Requirements: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.
 - 1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.
- D. Abbreviations and Acronyms for Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale Research's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."

END OF SECTION 01 4200

DIVISION 01 – GENERAL REQUIRMENTS

SECTION 01 5000 – TEMPORARY FACILITIES & CONTROLS

1. GENERAL

1.1 TEMPORARY UTILITIES

A. Temporary Heat

1. Mechanical Contractor shall obtain permits and applications as required to make temporary and permanent gas connection from the gas distribution system, and to provide temporary metering of all gas usage until substantial completion.
2. Mechanical Contractor shall provide all necessary piping, fittings, and accessories required for temporary gas service.
3. General Contractor shall pay all gas usage costs for temporary construction gas services until Substantial Completion and acceptance by the Owner.
4. Cleaning and Maintenance: of permanent equipment including filter cleaning and/or changes shall be the responsibility of the Mechanical Contractor until Substantial Completion of all contracts affecting Owner's use of the building.

B. Ventilation Required For Construction:

1. The building must be properly dried out as work progresses, particularly before interior finishes are applied. The Contractor shall furnish fans and pay for the operational cost as required for ventilation or drying of the work.

C. Sanitary Conveniences:

1. General Contractor shall provide, maintain, and remove when directed, suitable temporary sanitary convenience for use of all workmen on the project. No permanent fixtures may be used for this purpose except by written direction from the Architect.

D. Electricity and Lighting

1. Electrical Contractor shall obtain permits and applications as required to make temporary and permanent connections from the electric distribution system and to provide temporary metering of all electric usage until Substantial Completion.
2. Electrical Contractor to provide all necessary wiring and equipment required for temporary service except where portions of the permanent system can be utilized as part of the temporary system.
3. General Contractor to pay all electric usage costs for temporary/construction electric services until Substantial Completion and acceptance by Owner.
4. Electrical Contractor to install temporary circuit and branch wiring where necessary, with area distribution boxes located so that power and lighting is available throughout the use of construction-type power cords.
5. Electrical Contractor to provide adequate artificial lighting for all areas of work when natural light is not adequate for work. (5 ft. candles minimum)
6. Each Prime Contractor and subcontractor shall furnish their own extension cords.

E. Water

1. Mechanical Contractor shall obtain permits and applications as required to make temporary and permanent water service connection from the water distribution system, and to provide temporary metering of all water usage until substantial completion.
2. Mechanical Contractor shall provide all necessary piping, fittings, and accessories required for temporary water service.
3. General Contractor shall pay all water usage costs for temporary construction water services until Substantial Completion and acceptance by the Owner.

1.2 CONSTRUCTION FACILITIES

A. Temporary Facilities:

1. Contractors shall provide, maintain, and remove when directed, suitable temporary substantial storage building or trailer upon the site, located where directed by Architect. All materials, which may be damaged by storage in the open, shall be placed in storage building immediately upon delivery.
2. Contractors shall secure approval of Architect for all other means of storing and protecting such material.
3. General Contractors shall also provide and maintain a temporary field office equipped with heat, cellular telephone, e-mail address, plan desk and file. A record set of drawings shall be maintained by the General Contractor for his use and the other subcontractors. All approved Shop Drawings shall be kept on file in this office. Locate temporary field office where directed.

B. Temporary Protection

1. The General Contractor shall continuously maintain adequate protection of all work from damage, and shall protect the Owner's and adjacent property from damage, and people from injury, arising in connection with his contract. Trees shall be protected and care must be used to avoid damage to same. Plantings, fences, streets, surrounding areas, and structures that may be damaged by negligence shall be replaced or repaired as directed and cost paid for by responsible Contractor.
2. The General Contractor shall erect a construction fence four feet (4'-0") high completely around the construction area under use to prevent persons from entering the construction area.

C. Construction Aids and Enclosures

1. Tools, Scaffolding, Transportation, etc. – Except as otherwise specified, each Contractor and each Subcontractor shall furnish, at his own cost and risk, all transportation, tools, apparatus, hoists, derricks (including power for same), scaffolding and all temporary work and materials necessary for the prosecution of the Contract.
2. Temporary Enclosures – The General Contractor shall provide temporary weathertight enclosure of exterior walls for successive areas of the building as work progresses and as necessary to provide acceptable working conditions. Provide weather protection for interior materials, allowing for effective temporary heating and prevention of entry by unauthorized persons. Provide temporary exterior doors with self-closing hardware and padlocks. Other enclosures shall be removable as necessary for work and for handling of materials.

END OF SECTION 01 5000

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 01 6000 – PRODUCT REQUIREMENTS

1. GENERAL

1.1 SUMMARY

- A. This Section includes the following administrative and procedural requirements: selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.

1.2 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.
- D. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
- E. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.
- F. Furnish: To supply and deliver, unload, inspect for damage (same as supply).
- G. Install: To unpack, assemble, erect, apply, place, connect, finish, cure, protect, clean, and ready for use.
- H. Provide: To furnish or supply, plus install.
- I. Supply: To supply and deliver, unload, inspect for damage (same as furnish).

1.3 SUBMITTALS

- A. Substitution Requests: Submit one electronic copy of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within ten (10) days of receipt of request, or seven (7) days of receipt of additional information or documentation, whichever is later.
 - a. Form of Acceptance: Change Order.
 - b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.
 - 1. The Contractor and subcontractors are responsible for providing products and construction methods compatible with products and construction methods of other subcontractors.
 - 2. If a dispute arises between subcontractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
- B. Storage: Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Prime Contractor of obligations under requirements of the Contract Documents.
- B. Special Warranties: Prepare a written and electronic copy document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Specified Form: Forms are included with the Specifications. Prepare a written document using appropriate form properly executed.
- C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

2. PRODUCTS

2.1 PRODUCT OPTIONS

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Architect will make selection.
 5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
 6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
- B. Product Selection Procedures: Procedures for product selection include the following:
1. Product: Where Specification paragraphs or subparagraphs titled "Product" name a single product and manufacturer, provide the product named.
 - a. Substitutions may be considered, unless otherwise indicated.
 2. Manufacturer/Source: Where Specification paragraphs or subparagraphs titled "Manufacturer" or "Source" name single manufacturers or sources, provide a product by the manufacturer or from the source named that complies with requirements.
 - a. Substitutions may be considered, unless otherwise indicated.
 3. Products: Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
 - a. Substitutions may be considered, unless otherwise indicated.

END OF SECTION 01 6000

FORM 01 6000A

SUBSTITUTION REQUEST FORM

TO: ATURA Architecture
912 North 13th Street, Clear Lake, IA 50428
641-357-1923 email: reedw@aturaarchitecture.com

PROJECT: Garner Community Christian Child Care –
Garner Community Christian Child Care Center
Garner, IA Project No. 2024-122

SPECIFIED ITEM: _____

Section	Paragraph	Description
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The undersigned requests consideration of the following

PROPOSED SUBSTITUTION: _____

REASON FOR SUBSTITUTION: _____

CREDIT TO OWNER, _____ \$ _____ .00

Attached data includes product description, specifications, drawings, photographs, performance and test data adequate for evaluation of the request; applicable portions are clearly identified.

Attached data also includes description of changes to Contract Documents which proposed substitution will require for its proper installation.

The undersigned states that the following paragraphs, unless modified on attachments, are correct.

1. The proposed substitution does not affect dimensions shown on Drawings.
2. The undersigned will pay for changes to the building design, including engineering design, detailing, and construction costs caused by the requested substitution.
3. The proposed substitution will have no adverse effect on other trades, the construction schedule, or specified warranty requirements.
4. Maintenance and service will be locally available for the proposed substitution.

The undersigned states that the function, appearance, quality, and performance of the Proposed Substitution are equivalent or superior to the specified item.

SUBMITTED BY: _____ **ARCHITECT:** Atura Architecture

Signature	<input type="checkbox"/> Accepted	<input type="checkbox"/> Accepted As Noted
Firm	<input type="checkbox"/> Not Accepted	<input type="checkbox"/> Received Too Late
Address	By	
	Date	
Date	Remarks	
Telephone		
Email		

Attachments:

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 01 7000 – EXECUTION REQUIREMENTS

1. GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for the following:
 - 1. Cleaning.
 - 2. Dust Control.
 - 3. Refer to Sections 01 7329 for Cutting and Patching requirements. Refer also to General Conditions 3.14.

1.2 CLEANING

- A. Disposal Requirements:
 - 1. Contractor shall provide and maintain waste disposal containers suitable for temporary storage and disposal of construction debris, excess materials and waste material.
 - 2. Contractor shall regularly have waste materials removed from the Construction Site and disposed of in an approved manner at an approved disposal site.
 - 3. Contractors and Subcontractors shall conduct cleaning and disposal operations to comply with codes, ordinances, regulations and antipollution laws.
- B. Materials:
 - 1. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.
 - 2. Use only those cleaning materials and methods recommended by manufacturer of the surface material to be cleaned.
 - 3. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.
- C. During Construction:
 - 1. General Contractor and each Subcontractor shall weekly:
 - a. Dispose of accumulated debris and waste in containers provided by General Contractor.
 - b. Broom clean current week's work area and pick up rubbish and debris on the Construction Site.
 - 2. Scrap material still suitable for use shall be properly stored in a neat manner, otherwise such material shall be removed from the project site.
 - 3. Take steps as necessary to prevent construction debris from blowing onto adjacent sites. Promptly pick-up/remove any debris.
- D. Dust Control:
 - 1. General Contractor shall construct temporary partitions/barriers and seal openings, as required, to prevent dust from entering areas not affected by the project work.
 - 2. General Contractor shall clean interior spaces prior to the start of finish painting and continue cleaning on an as-needed basis until painting is finished. Sub-contractors shall minimize dust generation in finished areas and shall clean such areas if required.
 - 3. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.
- E. Final Cleaning: By Mechanical Subcontractor
 - 1. Ventilating system:
 - a. Clean permanent filters and replace disposable filters if units were operated during construction.
 - b. Clean ducts, blowers and coils if units were operated without filters during construction.

F. Final Cleaning: By responsible Contractors

1. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels and other foreign materials from sight-exposed interior and exterior surfaces.
2. Wash and shine glazing and mirrors. Polish glossy surfaces to a clear shine.
3. Clean cabinets inside and out, vacuum floors, clean plumbing fixtures and leave all items in condition for Owner occupancy.
4. Prior to Owner occupancy, conduct an inspection of sight-exposed surfaces and all work areas to verify that the entire work is clean.

1.3 CLOSE-OUT PROCEDURES

- A. Refer to Section 01 7700.

END OF SECTION 01 7000

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 01 7329 – CUTTING AND PATCHING

1. GENERAL

1.1 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. See Divisions 02 through 14 and 31 through 33 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
- C. Requirements in this Section apply to mechanical and electrical installations. See Divisions 22, 23, and 26 through 28 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.2 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
 - 1. Extent: Describe cutting and patching, show how they will be performed.
 - 2. For changes to existing construction not indicated on Drawings: Describe anticipated results, include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
 - 3. Products: List products to be used and firms or entities that will perform the Work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted.
 - 6. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.3 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
- C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1.4 WARRANTY

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

2. PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections of these Specifications.
- B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

3. EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
 - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to minimize interruption of services to occupied areas.

3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 5. Proceed with patching after construction operations requiring cutting are complete.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 4. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance. Refer to Drawings for extent.

END OF SECTION 01 7329

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 01 7700 – CLOSEOUT PROCEDURES

1. GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Inspection procedures.
 - 2. Project Record Documents.
 - 3. Operation and maintenance manuals.
 - 4. Warranties.
 - 5. Instruction of Owner's personnel.
 - 6. Final cleaning.
- B. See Divisions 02 through 33 Sections for specific closeout and special cleaning requirements for products of those Sections.

1.2 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
 - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 - 2. Advise Owner of pending insurance changeover requirements.
 - 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
 - 6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
 - 7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 8. Complete startup testing of systems.
 - 9. Submit test/adjust/balance records.
 - 10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 - 11. Advise Owner of changeover in heat and other utilities.
 - 12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 - 13. Complete final cleaning requirements, including touchup painting.
 - 14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.3 CLOSE-OUT SUBMITTALS

- A. Record Documents
- B. Operations and Maintenance Manuals
- C. Warranties and Bonds
- D. Evidence of payment and release of liens.
- E. Verify extra supplies/stock as required by Specification Section.
- F. Other miscellaneous forms and submittals as required by Contract Documents
- G. Final Payment And Adjustment Of Accounts:
 1. Contractor shall submit a final statement of accounting.
 - a. Statement shall reflect all adjustments to the Contract Sum

1.4 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
 1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
 2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
 1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 PROJECT RECORD DOCUMENTS

- A. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.
- B. Record Drawings: Maintain and submit one set of black-line white prints of Contract Drawings and Shop Drawings.
 1. Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
 - a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later.

- b. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
 - 2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
 - 3. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.
 - 4. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.
- C. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
- 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 - 3. Note related Change Orders and Record Drawings, where applicable.
- D. Miscellaneous Record Submittals: Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

1.6 OPERATION AND MAINTENANCE MANUALS

- A. Assemble a complete set of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:
- 1. Operation Data: Include emergency instructions and procedures, system and equipment descriptions, operating procedures, and sequence of operations.
 - 2. Maintenance Data: Include manufacturer's information, list of spare parts, maintenance procedures, maintenance and service schedules for preventive and routine maintenance, and copies of warranties and bonds.
- B. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.
- C. Form of Submittals:
- 1. Prepare data in form of an instructional manual for use by Owner's personnel.
 - a. Assemble in 3 ring binders.
 - b. Provide separate binder each for Architectural, Mechanical and Electrical.
 - c. In addition to a physical copy, provide an electronic copy.
- D. Content Of Manual:
- 1. Arrange manuals as follows. Provide tabs at main section and for each product/system.
 - a. ARCHITECTURAL
 - 1) Table of Contents
 - 2) Overall list of contractors and subcontractors on project with company name, address, contact person, phone number and system responsibility.
 - 3) Warranties as required by sections.
 - 4) Certifications/Reports:
 - a) Occupancy Permit.

- b) Manufacturers Roof Inspection Report.
- 5) Section on each product:
 - a) First sheet for each product section to list product, specification/drawing reference, responsible subcontractor /installer, supplier including company name, contact person, address and phone of supplier and installer.
 - b) Refer to specification for list of information to be included for each product.
 - c) Architectural Manual to include, but not limited to, the following applicable products: Door hardware; Ceiling tile; VCT flooring; Paint schedule and formulations; Windows; Carpeting.
- b. MECHANICAL (See Divisions 22 & 23, included in this Project Manual.)
- c. ELECTRICAL (See Division 26 through 28, included in this Project Manual.)

1.7 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Provide complete information for each item.
 - 1. Product or work item.
 - 2. Firm, with name of principal, address and telephone number.
 - 3. Date of beginning of warranty, bond or service maintenance contract.
 - 4. Duration of warranty, bond or service maintenance contract.
 - 5. Provide information for Owner's personnel:
 - a. Proper procedure in case of failure.
 - b. Instances which might affect the validity of warranty or bond.
- C. Include warranties in operation and maintenance manual binder.

1.8 EVIDENCE OF PAYMENT AND RELEASE OF LIENS

- A. Consent of Surety Company to Final Payment: AIA G707.
- B. Contractor's Affidavit of Payment of Debts and Claims: AIA G706.
- C. All submittals shall be in duplicate and duly executed before delivery to Architect.
- D. General Contractor shall submit the final Application for Payment in accordance with procedures and requirements stated in the Conditions of the Contract.

2. PRODUCTS

2.1 MATERIALS

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

3. EXECUTION

3.1 DEMONSTRATION AND TRAINING

- A. Instruction: After substantial completion and prior to contract close-out, fully instruct Owner's designated operating and maintenance personnel in operation, adjustment and maintenance of products, equipment and systems.
 - 1. Provide instructors experienced in operation and maintenance procedures.

2. Include manufacturer's representative when required.
 3. Where systems interface, schedule training session with all representatives to demonstrate/instruct on complete system.
 4. Operating and maintenance manual shall constitute the basis of instruction and shall be available during sessions. Review contents of manual with personnel in full detail to explain all aspects of operations and maintenance.
 5. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.
 6. Schedule training with Owner, through Architect, with at least seven days' advance notice.
 7. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.
- B. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. For each training module, develop a learning objective and teaching outline.
1. Include instruction for system design and operational philosophy, review of documentation, operations, adjustments, troubleshooting, maintenance, and repair.

3.2 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - g. Sweep concrete floors broom-clean in unoccupied spaces.
 - h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
 - i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - j. Remove labels that are not permanent.
 - k. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
 - l. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - m. Replace parts subject to unusual operating conditions.

- n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 - q. Leave Project clean and ready for occupancy.
- C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 01 7700

DIVISION 03 – CONCRETE

SECTION 03 2000 – CONCRETE REINFORCING

1. GENERAL

- 1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.
- 1.2 SCOPE – Furnish all labor, materials and equipment required to completely install Concrete Reinforcing shown on the drawings, as detailed, and as herein specified. The Contractor will be responsible for providing all work reasonably required under this Section Specification Heading.

Work under this SECTION shall include, but not necessarily be limited to, the following items:

- A. Reinforcing of concrete footing and foundation walls.
 - B. Reinforcing of concrete platform slabs.
 - C. Reinforcing for concrete thickened slabs.
 - D. Welded steel mesh reinforcement for interior concrete slabs, and elsewhere as shown.
 - E. Accessories such as saddles, chairs, chair supports, spacers, ties, dowels, sleeves, etc.
 - F. Any other reinforcement shown on the drawings.
 - G. Submittals for fabrication and placing.
- 1.3 RELATED WORK SPECIFIED ELSEWHERE
- A. Concrete – SECTION 03 3000 – CAST-IN-PLACE CONCRETE.
 - B. Concrete Masonry Unit Reinforcing – SECTION 04 2000 – UNIT MASONRY.
- 1.4 SUBMITTALS – Shall be submitted and approved before fabrication and shipment. Shop Drawings shall indicate bending and placement and shall show locations of saddles, chairs, supports, and other accessories. Submittal shall be in accordance with SECTION 01 3300 – SUBMITTAL REQUIREMENTS. NOTE: Where straight rod only is required in the footings or reinforced masonry, shop drawings and prior approval will not be required but field inspection and approval by the Owner's Representative will be required before pouring concrete.

2. PRODUCTS

2.1 MATERIALS

- A. REINFORCING BARS – All reinforcing bars shall conform to "Specifications for Billet-Steel Bars" for concrete reinforcement ASTM Specification A615-60. They shall be free of rust, scale and other foreign matter that might impair the development of design stresses and bond. Deformation shall conform to ASTM Specification A-305.
- B. MESH REINFORCEMENT – Shall be a welding wire fabric conforming to ASTM Specification A-185. Concrete floor slabs on grade, 4" thick, shall be reinforced with 6x6 W1.4x W1.4 welded wire fabric reinforcement, unless otherwise noted. Concrete floor

slabs on grade, 6" thick, shall be reinforced with 6x6 W2.1x W2.1 welded wire fabric reinforcement, unless otherwise noted.

3. EXECUTION

3.1 WORKMANSHIP AND INSTALLATION

- A. FABRICATION – All bars shall be delivered to the site, bent to conform accurately to details and shall be cold bent. They shall not be bent in a manner that will injure the material. Bars with kinks or bends not called for on the drawings will not be used.
- B. PLACING – Reinforcement shall be accurately placed in accordance with the approved shop drawings and securely held in place during placement of concrete by spacers, chairs, and wiring. Supports shall be sufficient in numbers and sizes to comply with the specification of the Concrete Reinforcement Steel Institute. Laps shall be as noted on the drawings.
- C. STANDARDS – All work under this heading shall conform to the applicable specifications of:
 - 1. Concrete Reinforcing Steel Institute.
 - 2. American Concrete Institute.
 - 3. American Society of Testing Materials.
 - 4. U.S. Department of Commerce R26.50.
 - 5. "Manual of Standard Practice for Detailing Reinforced Concrete Structure (ACI 315.51)" and shall conform to the A.S.I., latest edition.
- D. COVERAGE – Bars, in all cases, are to be spaced so as to permit concrete to thoroughly surround all reinforcing steel. See Structural Drawings for minimum coverages.
- E. INSPECTION – Cooperate with Architect to facilitate inspection of all reinforcement after same is placed in forms and before concrete is poured.

END OF SECTION 03 2000

DIVISION 03 – CONCRETE

SECTION 03 3000 – CAST-IN-PLACE CONCRETE

1. GENERAL

- 1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.
- 1.2 SCOPE – Furnish all labor, materials and equipment required to complete all Cast-in-Place Concrete and all Concrete Form Work shown on the drawings, as detailed, and as herein specified. The Contractor will be responsible for providing all work reasonably required under this Section Specification Heading.

Work under this SECTION shall include, but not necessarily be limited to, the following items:

- A. Concrete footings and foundation walls.
- B. Concrete slabs on-grade (interior).
- C. Miscellaneous concrete grouting and patching.
- D. All concrete forming.
- E. All other miscellaneous cast-in-place concrete as required for completion of the work.
- F. Expansion material and miscellaneous concrete accessories.
- G. Mix Designs and Testing by Independent Laboratory.
- H. Concrete platform slabs.
- I. Miscellaneous concrete related work.
- J. Concrete floor curing compound.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Reinforcing – SECTION 03 2000 – CONCRETE REINFORCING.
 - B. Concrete Masonry Unit Bond Beams – SECTION 04 2000 – UNIT MASONRY.
 - C. Perimeter and Underslab Insulation – SECTION 07 2000 – THERMAL PROTECTION.
 - D. Vapor Seal Membrane – SECTION 07 2500 – WEATHER BARRIERS.
 - E. Site fill, compaction, and testing – SECTION 31 0000 – EARTHWORK.
- 1.4 DESIGN MIX – The Contractor is to submit for approval test data by an Independent Testing Laboratory for a Design Mix to comply with the twenty-eight (28) day strength requirements of this specification. The approved, tested, Design Mix shall be followed for the mixing of all concrete delivered to the forms. Submit the Design Mix including test cylinder break data, for approval by the Architect, one (1) week before concrete is to be poured.
- 1.5 FIELD TESTS AND SAMPLES – Shall be conducted by a special inspections agent hired by the Owner. The Contractor shall coordinate the special inspections agent's work in accordance with Division 01 4000, Quality Requirements, 1.8 Quality Control.

2. PRODUCTS

2.1 CONCRETE STRENGTH

- A. See structural drawings for minimum concrete compressive strengths.
- B. All concrete for interior slabs on grade, bond beams, miscellaneous items, etc. shall be minimum of 4,000 PSI compressive strength at twenty-eight (28) days.
- C. All exterior, exposed concrete platforms, slabs on-grade, sidewalks, etc., shall be minimum of 4,000 PSI compressive strength at twenty-eight (28) days and contain an air entraining agent for 6% (+1%) air content.
- D. All footings and foundation walls shall be minimum 4,000 psi compressive strength at twenty-eight (28) days.
- E. All strengths will be finally established and determined by proper cylinder tests as specified herein.

2.2 CONCRETE – Shall be a ready mix product using a design mix, prepared and tested by an independent testing laboratory, approved by the Architect, of a minimum cement content and minimum strength as later specified, using the following materials:

A. CEMENT

- 1. All Portland Cement for all concrete work shall conform to ASTM Specification A150, Type 1.

B. CONTRACTOR'S OPTION: CEMENT REPLACEMENT – FLY ASH – Fly ash shall meet the requirements of ASTM C 618 for a Class C or Class F material.

- 1. Replacement Ratio (Amount) – Portland Cement shall be replaced on a 1:1 basis by fly ash. The fly ash amount shall be expressed as a percent, by mass, of the total cementitious materials content.
- 2. Amount – For mixtures featuring only portland cement and fly ash as the cementitious materials, the fly ash replacement amount shall be fifteen (15%) percent for Class C and Class F, of total cementitious material.
- 3. Water-Cementitious Materials Ratio – The full mass (weight) of both the portland cement and the fly ash shall be included in the denominator of the water-cementitious materials ratio (w/(c+m) or (w/c) calculation.
- 4. Yield – Adjust the yield of the mixture to reflect use of fly ash and, if applicable, the lowered water content.

C. AGGREGATE

- 1. COURSE AGGREGATE – Shall be crushed stone or gravel and shall conform to ASTM Specification C33-IT.
- 2. SAND – Shall be composed of grains graded from course to fine, clean and free from loam, shale, and dust and shall equal in quality the best bank sand conforming with ASTM Specification C33.
- 3. CONTRACTOR'S OPTION: RECYCLED CRUSHED CONCRETE – Shall be in accordance with ASTM Specification C33. A minimum of fifteen (15%) percent, by volume, of the total aggregate shall be recycled crushed concrete.
- 4. AGGREGATE SIZE – Shall be in accordance with highest class work and shall be in accordance with that established in the Design Mix herein described.

D. WATER – Water used for mixing concrete shall be clean and free from harmful acids,

alkalies, or organic material.

E. ADMIXTURES

1. An air entraining agent conforming to ASTM Specification C260 shall be used in the mix of all concrete for exterior, exposed use in accordance with the manufacturer's instructions for six (6%) percent air content.
2. No other admixtures are to be added without data submission and prior approval of the Architect.

2.3 EXPANSION JOINT FILLER – Shall be Deck-O-Foam flexible foam as manufactured by W. R. Meadows in the thicknesses as detailed on the Drawings.

2.4 JOINT SEALANT AT EXTERIOR EXPANSION JOINTS – Expansion joints in exterior concrete walks, slabs and abutting building shall be sealed with a one-part polyurethane equal to Vulkem 45SSL by Tremco Incorporated or MasterSeal NP-1 by BASF.

2.5 GROUT – Under steel column base plates and elsewhere where detailed or required shall be equal to BASF Master Builders MasterFlow 928. Minimum design compressive strength shall be 4,000 psi.

2.6 CONCRETE FLOOR CURING & SEALING COMPOUND – Shall be MasterKure CC 180WB by BASF, or approved equal.

2.7 JOINT SEALANT AT INTERIOR CONCRETE SLAB – Shall be self-leveling, one-part polyurethane, MasterSeal SL-1 by BASF, or approved equal.

2.8 FORM MATERIALS

- A. FOR UNEXPOSED CONCRETE – Shall be formed with clean, straight lumber, plywood or steel forms. Repair and clean forms before re-use.
- B. FOR EXPOSED CONCRETE – Shall be formed with medium or high density overlaid, exterior type, Plywood, American Plywood Association Plyform Class 1 with B-Grade faces, or steel forms in good condition, which results in smooth surfaces without fins or other irregularities.
- C. FORM TIES – Unless otherwise noted, form ties shall be the removable type which will leave no metal closer than 1 ½" from the exposed faces of the concrete.
- D. FORM COATING – Coat forms with material what will NOT stain or cause injury to concrete surfaces, or wood forms, or prevent future application of paint or other finishes. The Architect must approve the product to be used prior to any coating or forms.

2.9 CONCRETE SLAB REPAIR SYSTEM – Shall be MasterEmaco T 310 CI by BASF, or approved equal. One component polymer-modified cementitious mortar. For application thickness greater than 1", add aggregate as recommended by the manufacturer.

3. EXECUTION

3.1 TRANSIT CONCRETE – Concrete will be mixed and delivered by a central batching plant. The plant must have proper and adequate facilities for the storage of concrete

ingredients and the proper mixing and delivery of the Contract requirements. The equipment must include means for the accurate determination of the amount of surface water carried by the aggregates.

Required water shall be measured at the mixing plant and any addition of water enroute or at the job site shall be sufficient cause for immediate rejection of the batch to which water was added. "Mobile Mixing" is not approved as a method type for this project.

3.2 MIXING

- A. CONTROL – The ingredients shall be in the proportions set forth in the Testing Laboratory's Design Mix. Unless otherwise noted on the drawings, slumps shall be as follows:

For trenched footings 3" to 5", footings 2" to 4", walls 3" to 5", slabs 2" to 4". For Machine Vibrated Concrete the lower of the two (2) slumps shall be maintained.

- 3.3 DEFECTIVE AREAS AND PATCHING – Grind bulges, fins, form marks, rough spots in exposed concrete. Honeycomb and other defective areas chipped out to solid concrete (Minimum depth 1"), cutting edges straight as possible and at right angles to surface. Dampen patch and surrounding area with water, brush on grout of equal parts Portland Cement and sand followed immediately by patching mortar. Patch mortar to be not richer than one (1) part cement to three (3) parts sand (white portland cement shall be substituted for a part of the gray portland cement to match color of surrounding concrete). Finish patch to match adjoining surface. Keep moist twenty-four (24) hours. Patch all form tie break-back holes on exterior side of foundation walls or where exposed using same methods as patching.

NOTE: Any patching of existing concrete where there has been removal and demolition, shall be done the same as for above defective areas.

3.4 FLOOR SLABS ON GROUND

- A. Provide construction or control joints in the floor slabs on ground as shown on the drawings or not to exceed 15'-0" o.c. These joints may be sawed to a depth of $\frac{1}{4}$ the slab thickness. In both cases the reinforcing shall run through the joints. A minimum of forty-eight (48) hours is to elapse before placing adjacent floor panels.
- B. The joints of interior slabs shall be formed by turning the vapor barrier up the wall (exterior and interior) to the top of the slab, forming a bond break. Perimeters of exterior slabs shall have $\frac{1}{2}$ " thick expansion material held down $\frac{1}{2}$ " and sealed with sealant as previously specified.
- C. Floors shall positively pitch to drains so that no water stands in low areas.

3.5 CONCRETE JOINTS

- A. CONSTRUCTION JOINTS – Provide keyed, tongue and groove joints in slabs on grade when one-half hour or more elapses between concrete pours. Reinforcing to be continuous. A minimum of 48 hours is to elapse before placing adjacent floor pour.

- B. CONTROL JOINTS – Sawcut 1/8" wide, 1/4 slab thickness, when cutting action will not tear, abrade, or otherwise damage surfaces and before concrete develops random contraction cracks.
- C. EXTERIOR JOINT SPACING – Locate joints five (5') ft. o.c. maximum each way unless drawings indicate a different spacing.
- D. INTERIOR JOINT SPACING – Provide 1/8" wide joints in all slabs on-grade unless specifically noted otherwise. Locate approximately 15'-0" o.c. each way, unless otherwise noted on the drawings. Locate under walls to conceal joints where possible.
- E. ISOLATION JOINTS (INTERIOR) – Provide isolation joints between vertical surface and concrete slab and where walls or columns extend through slabs. Perimeter joints shall be formed by turning the vapor barrier up the wall to the top of the slab as a bond breaker.
- F. EXPANSION JOINTS (EXTERIOR) – There shall be installed a 1/2" thick expansion joint material, full thickness of the slab. Set top of filler approximately 1/2" below concrete surface. Locate between entry platform and walks; new sidewalk adjoining existing; direction change in slabs on grade and walks; buildings and adjoining slabs; and where indicated on the drawings. Fill joints level with sealant. Follow manufacturer's instructions for preparation and installation.
- G. Apply self-leveling sealant at all exposed concrete floor slab exposed joints – control and construction joints.

3.6 CONCRETE PLACEMENT

- A. SCREEDS – Set accurately to place concrete to depths and slopes indicated. Floors shall pitch positively to drains and exterior concrete sloped to drain so that no water stands in trapped pockets. See slab tolerances.
- B. DEPOSITING CONCRETE – When placing concrete on-grade, sprinkle subgrade with water where vapor barrier is not present. Do not place on muddy or frozen grade. Deposit continuously or in layers of such thickness that no concrete will be deposited on material which has hardened enough to cause the formation of seams or planes of weakness. Deposit concrete in its final location as nearly as possible so not to cause segregation of aggregate. Consolidate placed concrete with hand rodding and tamping so that concrete is worked around reinforcement and other embedded items and into all parts of the forms. The use of mechanical vibrating equipment shall be approved by the Architect.

3.7 EXTERIOR PLATFORMS AND SIDEWALKS – The construction of this work shall be in accordance with the drawings.

3.8 FORM AND SHORING REMOVAL

- A. Form and shoring removal shall not occur until concrete is sufficiently hard to prevent injury to surface or until the members have acquired enough strength to safely support all dead and live loads to be placed thereon.

- B. Minimum time for form and shoring removal for beam sides, column piers, walls, etc. will be thirty-six (36) hours.
 - C. The Responsibility for Form and Shoring Removal Rests entirely with the General Contractor.
- 3.9 EMBEDDED ITEMS – The Contractor shall carefully examine the drawings and build in all blocking, anchor slots, anchors, shelf angles, welding plates, furring devices, bolts, chases, reglets, as indicated or as may be required. Reinforcing shall be inspected and approved by the Architect before concrete is placed.
- 3.10 FINISHING
- A. Interior Floor Slabs – Shall be screeded level floated and smooth trowelled, unless specified otherwise.
 - B. Exterior Platforms, Stairs, and Sidewalks – Shall be finished with a broom finish. Provide ½” expansion joint material, full thickness of slab where concrete abuts building or as shown elsewhere. Expansion joint material shall be located from the bottom of the concrete slab to ½” below the top of the concrete slab.
 - C. Tolerances for All Surfaces – Shall be not more than 1/8” in 10'-0”.
- 3.11 CONCRETE FLOOR CURING COMPOUND – Apply one (1) coat of curing compound upon finishing concrete slabs. The concrete surface must be damp, but not wet. Apply material to form a continuous, uniform film by sprayer. At project conclusion, thoroughly clean and prepare concrete slab and apply one (1) coat of curing compound in accordance with the manufacturer’s instructions.
- 3.12 RUBBED FINISH – Where so noted on the drawings, hand rub concrete with cement slurry to texture and pattern as approved by the Architect.
- 3.13 WORKMANSHIP – All work shall be done in accordance with the best current practice of the trade. The Contractor shall protect the existing building from splatter, marking, etc. and shall thoroughly clean up all areas after operations are complete.

END OF SECTION 03 3000

DIVISION 04 – MASONRY

SECTION 04 4200 – STONE CLADDING

1. GENERAL

1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.

1.2 SCOPE – Furnish all material, labor, equipment, transportation and perform all operations to complete all Stone Cladding Work, complete as shown on the drawings and, as herein, specified. The Contractor will be responsible for all work that is required under this SECTION Specification Heading.

Work involved under this SECTION shall include, but not necessarily be limited to, the following items:

- A. Thin-set Stone Veneer.
- B. Mortar (cement, lime, sand and water).
- C. Protection of masonry and masonry materials.
- D. Laying of masonry, including all "building-in" of other work embedded items, wall ties, etc., specified herein or elsewhere.
- E. Cleaning of masonry.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Rough Carpentry – SECTION 06 1000 – ROUGH CARPENTRY.

1.4 QUALITY ASSURANCE – Provide a mock-up panel (36" x36" min.) for evaluation of surface preparation techniques, application workmanship, and color of stone and mortar.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store stone materials on pallets on a dry level surface. Pallets shall not be stacked and shall be covered with tarps.
- C. Store mortar under cover and in an area where temperature is maintained between 40 degrees F to 110 degrees F.

1.6 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Hot and Cold Weather Requirements: In accordance with ACI 530.1/ASCE 6/TMS 602 Specifications for Masonry Structures.

- C. Ambient temperature shall be 40 degrees F or above during erection of stone masonry. When ambient temperature falls below 50 degrees F, mortar mixing water shall be heated.

2. PRODUCTS

2.1 MORTAR

- A. MORTAR – Shall conform to ASTM Specification C-270 and shall be Mortar Type "S", having an ultimate compressive strength of 1,800 PSI at 28 days mixed in the proportion of one (1) part Portland Cement, one-half (½) part hydrated lime and four (4) parts sand by volume. Use "Spec Mix" premixed colored mortar
- B. PORTLAND CEMENT – Shall be Type 1, ASTM Specification C-150, Northwestern States Brand or equal. Only one (1) brand shall be used on the entire project.
- C. LIME – C-207, high pressure hydrated Type "S" (non-air-entrained).
- D. SAND – Complying with ASTM Specification C-144 not to contain over 1.0% of clay lumps or shale, with the following percentages of sizes:
 - 1. Passing Sieve Size No. 8..... 95 to 100%
 - 2. Passing Sieve Size No. 30..... 35 to 70%
 - 3. Passing Sieve Size No. 50..... 15 to 35%
 - 4. Passing Sieve Size No. 100..... 2 to 15%

Material will be tested for compliance prior to the beginning of the project with results submitted to the Architect for approval.

- E. WATER – Shall be clean and free of deterious amounts of acids, alkalis, salts or organic materials.
- F. POLYMER MODIFIED STONE VENEER MORTAR (PMSVM) – Shall be Spec Mix PMSVM or approved equal, and conform to ASTM A118.4.
- G. PREPARATION OF MORTAR
 - 1. Mortar shall be mixed in a mechanical mixer for at least two (2) minutes after all materials are in the drum.
 - 2. The specified proportions of mortar material shall be controlled and accurately maintained during the entire program of the work including mortar color where specified later herein.
 - 3. Thoroughly mix cementitious materials and aggregate with the proper amount of water to produce satisfactory workability.
- H. TEMPERING – After initial mixing, the mortar shall be kept tempered by adding water as required for good workability. Mortar must be used within 2 ½ hours, at temperatures of 80 degrees F and above, and in no case shall it be used after 3 ½ hours after mixing.

2.2 THIN-SET STONE VENEER

- A. MANUFACTURER – Shall be Eldorado Stone, or approved equal.

B. PATTERN – SierraCut24.

1. Heights: 12”.
2. Lengths: 24”.
3. Nominal Thickness: 1” to 2.625”
4. Color: Monument.

C. ACCESSORIES

1. Expanded Metal Lath Paper Backed – ASTM C-847, galvanized, self-furring mesh of weight to suit application, backed with paper.
2. Expanded Metal Lath – ASTM C-847, galvanized, self-furring.
3. Lath Anchorage – Tie wire, nails, screws, and other metal supports, galvanized, of type and size to suit application and to rigidly secure materials in place.
4. Building Paper – ASTM D-226, 30# asphalt saturated felt.
5. Concrete Bonding Agent – Latex type as approved by the stone manufacturer.
6. Setting Buttons and Shims – Plastic.

3. EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until backing structure is plumb, bearing surfaces are level and substrates are clean and properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods for achieving the best result for the substrate under the project conditions.
- C. Prepare for installation over plywood sheathing as follows:
 1. Cover plywood sheathing with waterproof building paper with all joints lapped shingle style a minimum of 4”.
 2. Install metal lath in accordance with ASTM C 1063. Apply metal lath with long dimension perpendicular to supports and with joints lapped a minimum 1”. Secure laps with tie wire where they occur between supports.
 3. Fasten lath to wood supports using galvanized nails at maximum 6” on center vertically and 16” on center horizontally. Fasten with a minimum of a 1” penetration of the wood studs. Stop lath 1” from finished edges.
- D. Prepare for installation over concrete as follows:
 1. Clean or sandblast existing or new concrete or concrete masonry to assure a proper mortar bond. Verify no bituminous, water repellent, or form release agents exist on concrete surface that are detrimental to mortar bond.
 2. Apply bonding agent in accordance with the manufacturers printed instructions.
 3. Install metal lath in accordance with ASTM C 1063. Apply metal lath with long dimension perpendicular to supports and with joints lapped a minimum 1”. Secure laps with tie wire where they occur between supports.

4. Attach lath to concrete using galvanized concrete nails at maximum 6" on center vertically and 16" on center horizontally. Stop lath 1" from finished edges.
- E. Application of Base Coat:
1. Apply scratch coat in accordance with PCA Plaster (Stucco) Manual.
 2. Apply scratch coat to nominal thickness of $\frac{1}{2}$ " to $\frac{3}{4}$ " over metal lath surfaces.
 3. If weather is hot or surface is dry, dampen previous coat prior to applying mortar and thin-set stone veneer.
 4. If scratch coat is done in advance use notch trowel to create texture for better bond. Smooth surface is not acceptable for bond.
- F. Prepare for the installation of thin-set stone veneer as follows:
1. Coordinate placement of reinforcement, anchors and accessories, and flashings and other moisture control products supplied by other sections.
 2. Clean all built-in items of loose rust, ice, mud, or other foreign matter before incorporating into the wall. All ferrous metal built into the wall shall be primed or galvanized.

3.3 INSTALLATION

- A. Install thin-set stone veneer and mortar in accordance with ACI 530.1/ASCE 6/TMS 602 Specifications for Masonry Structures.
- B. Maintain masonry courses to uniform dimension(s). Form vertical and horizontal joints of uniform thickness.
- C. Pattern Bond:
1. Lay out work in advance and distribute color range of stone uniformly over total work area.
 2. Lay stone with the face exposed. Take care to avoid a concentration of any one color to any one wall surface.
 3. Maintain an approximate $\frac{1}{2}$ " joint, as stone allows.
 4. Do not use stacked vertical joints.
- D. Placing and Bonding:
1. Dampen substrate as required to reduce excessive suction.
 2. Apply mortar in accordance with PCA Plaster (Stucco) Manual to a thickness of $\frac{1}{2}$ " to $\frac{3}{4}$ ". Do not spread more than a workable area of 5 to 10 SF so that mortar will not set before stone is applied.
 3. Lay thin-set stone veneer in a full bed of mortar with full head joints.
 4. Work from the bottom up laying corner pieces first.
 5. Remove excessive mortar as work progresses.
 6. Do not shift or tap stone veneer after mortar has achieved initial set. Where adjustment is required, remove mortar and replace.
 7. Isolate top of stone veneer from horizontal structural framing members and slabs or decks with compressible joint filler and sealant in accordance with Section 07 9000.
- E. Joining Work: Where fresh masonry joints partially set masonry.
1. Remove loose stone and mortar.
 2. Clean and lightly wet surface of set masonry.
 3. To avoid a horizontal run of masonry rack back $\frac{1}{2}$ the length of stone in each course.

4. Toothing is not permitted.

F. Joints:

1. Lay stone with an approximate $\frac{1}{2}$ " mortar joint, as stone allows.
2. Tool joints when "thumb-print" hard with a round jointer slightly larger than the width of the joint.
3. Trowel-point or concave tool exterior joints below grade.
4. Flush cut joints to be finished with a soft brush only.
5. Retempering of mortar is not permitted.
6. Use non-corrosive stone shims as required to maintain uniform joint thickness.

G. Control and Expansion Joints: Keep joints open and free of debris. Coordinate control joint in accordance with Section 07 9000 for sealant performance.

H. Sealant Recesses: Provide open joint $\frac{3}{4}$ " deep and $\frac{1}{4}$ " wide, where masonry meets doors, windows and other exterior openings. Coordinate sealant joints in accordance with Section 07 9000 for sealant performance.

I. Cutting And Fitting: Cut and fit for chases, pipes, conduit, sleeves, grounds, and other penetrations and adjacent materials. Coordinate with other sections of work to provide correct size, shape, and location.

J. During the progress of the work cover the top of unfinished stone masonry work to protect it from the weather during erection.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

3.5 CLEANING

A. Keep the face of stone free of mortar as the work progresses. If residual mortar is on the face of the stone, allow to dry partially and brush the mortar off the surface and sponge off the residue.

B. When the work is completed and the mortar has set for 2 to 3 days the surface may be cleaned from top to bottom using a mild masonry detergent acceptable to the stone manufacturer. Do not use metal brushes or acids for cleaning.

END OF SECTION 04 4200

DIVISION 04 – MASONRY

SECTION 04 7200 – CAST STONE MASONRY

1. GENERAL

1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.

1.2 SCOPE – Furnish all material, labor, equipment, transportation and perform all operations to complete all Cast Stone Masonry Work, complete as shown on the drawings and, as herein, specified. The Contractor will be responsible for all work that is required under this SECTION Specification Heading.

Work involved under this SECTION shall include, but not necessarily be limited to, the following items:

- A. Cast Stone Masonry Units.
- B. Laying of Cast Stone Masonry Units, including all “building-in” of other work embedded items, wall ties, etc. specified herein or elsewhere.
- C. Protection of Cast Stone Masonry Units.
- D. Cleaning of Cast Stone Masonry Units.
- E. Submittals.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Unit Masonry – SECTION 04 2000 – UNIT MASONRY.
- B. Backer Rod and Sealant – SECTION 07 9000 – JOINT PROTECTION.

1.4 SUBMITTALS

- A. SHOP DRAWINGS – The manufacturer shall submit drawings to the Architect for their approval. Drawings shall show layout, dimensions, and all details necessary for the proper installation. Manufacturing shall not begin prior to shop drawing approval. Submittal shall be in accordance with SECTION 01 3300 – SUBMITTAL REQUIREMENTS.

1.5 QUALITY ASSURANCE

- A. MANUFACTURER'S QUALIFICATIONS – Minimum five (5) years continuous successful experience in fabricating cast stone materials, with demonstrated ability, facilities and manufacturing capacity required to furnish cast stone requirements of this project without delay of work in progress..
- B. MANUFACTURING STANDARDS – Comply with recommendations for manufacturing tolerances, procedures and productions methods of the Cast Stone Institute.
- C. INSTALLER'S QUALIFICATIONS – Minimum of five (5) years successful experience in handling and installing cast stone units on projects of comparable size and scope.

1.6 DELIVERY, STORAGE AND HANDLING

- A. PACKING AND SHIPPING – Provide protective covering and crating for finished surfaces to prevent damage during shipping.
 - 1. Identify and mark individual units with same mark as indicated on approved shop and setting drawings.
 - 2. Manufacturer shall provide itemized shipping list to accompany shipping bill of lading.
 - 3. Manufacturer shall coordinate shipment scheduling with installing contractor to minimize on-site handling and storage time.
- B. STORAGE AND PROTECTION – When on-site storage is necessary, store stone units and accessory components under cover, off the ground, away from areas subject to high humidity conditions.
 - 1. Where extended on-site storage is necessary, provide non-staining wood cribbing between stacked units to promote air circulation and prevent condensation.

2. **PRODUCTS**

2.1 MANUFACTURERS

- A. Edwards Cast Stone Company, Dubuque, IA.
- B. American Artstone Company, New Ulm, MN.
- C. Other manufacturers, with approval by Architect prior to bidding.

2.2 CAST STONE MASONRY

- A. Comply with ASTM C 1364.
- B. Physical properties: Provide the following:
 - 1. Compressive Strength – ASTM C 1194 – 6,500 psi minimum for products at 28 days.
 - 2. Absorption – ASTM C 1195 – 6% maximum by the cold water method, or 10% maximum by the boiling method for products at 28 days.
 - 3. Air Content – ASTM C173 or C231, for wet cast product shall be 4-8% for units exposed to freeze-thaw environments. Air entrainment is not required for VDT products.
 - 4. Freeze-thaw – ASTM C 1364 – The CPWL shall be less than 5% after 300 cycles of freezing and thawing.
 - 5. Linear Shrinkage – ASTM C 426 – Shrinkage shall not exceed 0.065%.

2.3 RAW MATERIALS

- A. Portland Cement – Type I or Type III, white and/or grey, ASTM C 150.
- B. Coarse aggregates – Granite, quartz or limestone, ASTM C33, except for gradation, and are optional for the VDT casting method.
- C. Fine Aggregates – Manufactured or natural sand, ASTM C33, except for gradation.
- D. Colors – Inorganic iron oxide pigments, ASTM C979 except that carbon black pigments shall not be used.

- E. Admixtures – Comply with the following:
 - 1. ASTM C260 for air-entraining admixtures.
 - 2. ASTM C494/C495M Types A-G for water reducing, retarding, accelerating and high range admixtures.
 - 3. Other admixtures – Integral water repellents and other chemicals, for which no ASTM Standard exists, shall be previously established as suitable for use in concrete by proven field performance or through laboratory testing.
 - 4. ASTM C618 mineral admixtures of dark and variable colors shall not be used in surfaces intended to be exposed to view.
 - 5. ASTM C989 granulated blast furnace slag may be used to improve physical properties. Tests are required to verify these features.
- F. Water – Potable, free of impurities.
- G. Reinforcing Bars:
 - 1. ASTM A615/A 615M. Grade 40 or 60 steel galvanized or epoxy coated when cover is less than 1.5".
 - 2. Welded Wire Fabric – ASTM A185 where applicable for wet cast units.

2.4 ACCESSORIES

- A. CLIPS, PLATES, AND MISCELLANEOUS ANCHORS – ASTM Type 304 or 316 stainless steel for items in direct contact with cast stone, unless specifically indicated otherwise.
 - 1. Anchoring veneer to miscellaneous substrates – Stainless steel angles and split-tail anchors.
 - 2. Anchors to concrete or concrete masonry backup – Bolts with expansion shields.
 - 3. Corners – Cramp anchors for anchoring stones together.
- B. BOLTS – ASTM A307, galvanized in accordance with ASTM A153, unless otherwise indicated.
- C. OTHER FASTENERS – Stainless steel or steel galvanized after fabrication in accordance with ASTM A123.
- D. SETTING BUTTONS, SHIMS, AND SHEET – Lead or resilient plastic, nonstaining, thickness to suit joint thickness. For pointed joints, sized to avoid interference with pointing operation.

2.5 COLOR AND FINISH

- A. Match sample on file in Architect's office.
- B. All surfaces intended to be exposed to view shall have a fine-grained texture similar to natural stone, with no air voids in excess of 1/32" and the density of such voids shall be less than 3 occurrences per any 1 sq.in. and not obvious under direct daylight illumination at a 5 ft. distance.
- C. Units shall exhibit a texture approximately equal to the approved sample when viewed under direct daylight illumination at a 10 ft. distance.
 - 1. ASTM D2244 permissible variation in color between units of comparable age subjected to similar weathering exposure.

- a. Total color difference – not greater than 6 units.
 - b. Total hue difference – not greater than 2 units.
- D. Minor chipping resulting from shipment and delivery shall not be grounds for rejection. Minor chips shall not be obvious under daylight illumination at a 20 ft. distance.
 - E. The occurrence of crazing or efflorescence shall not constitute a cause for rejection.
 - F. Remove cement film, if required, from exposed surfaces prior to packaging for shipment.

2.6 REINFORCING

- A. Reinforce the units as required by the drawings and for safe handling and structural stress.
- B. Minimum reinforcing shall be 0.25% of the cross section area.
- C. Reinforcement shall be non-corrosive where faces exposed to weather are covered with less than 1.5" of concrete material. All reinforcement shall have minimum coverage of twice the diameter of the bars.
- D. Panels, soffits, and similar stones greater than 24" in one direction shall be reinforced in that direction. Units less than 24" in both their length and width dimension shall be non-reinforced unless otherwise specified.
- E. Welded wire fabric reinforcing shall not be used in dry cast products.

- 2.7 CURING – Cure units in a warm curing chamber approximately 100 degrees F. at 95% relative humidity for approximately 12 hours, or cure in a 95% moist environment at a minimum 70 degrees F. for 16 hours after casting. Additional yard curing at 95% relative humidity shall be 350 degree days (i.e. 7 days @ 50 degrees F. or 5 days @ 70 degrees F. prior to shipping. Form cured units shall be protected from moisture evaporation with curing blankets, or curing compounds after casting.

2.8 MANUFACTURING TOLERANCES

- A. Cross section dimensions shall not deviate by more than +/- 1/8" from approved dimensions.
- B. Length of units shall not deviate by more than length/ +/- 1/8", whichever is greater, not to exceed +/- 1/4"
 - 1. Maximum length of any unit shall not exceed 15 times the average thickness of such unit unless otherwise agreed by the manufacturer.
- C. Warp, bow or twist of units shall not exceed length/ 360 or +/- 1/8", whichever is greater.
- D. Location of dowel holes, anchor slots, flashing grooves, false joints and similar features– On formed sides of unit, 1/8", on unformed sides of unit, 3/8" maximum deviation.

2.9 PRODUCTION QUALITY CONTROL

A. TESTING

1. Test compressive strength and absorption from specimens selected at random from plant production.
2. Samples shall be taken and tested from every 500 cu.ft. of product produced.
3. Perform tests in accordance ASTM C1194 and C1195.
4. New and existing mix designs shall be tested for strength and absorption compliance prior to producing units.

3. EXECUTION

- 3.1 EXAMINATION – Examine surfaces to receive cast stone work and conditions under which materials will be installed. Report in writing any conditions which do not comply with specified requirements. Do not proceed with installation until surfaces and conditions meet requirements for acceptable installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. COORDINATION – Verify that installation of items required for stonework to be installed by others are proper type, size, finish and are located at proper spacing with proper anchorage.
- B. CLEANING – Clean stone surfaces prior to setting, using only water or mild cleaning compounds containing no caustic or abrasives.

3.3 JOINTING

A. JOINT SIZE

1. At stone/brick joints 3/8".
2. At stone/stone joints in vertical position 1/4" (3/8" optional).

B. JOINT MATERIALS

1. Mortar, Type N, ASTM C270, color to match cast stone.
2. Use a full bed of mortar at all bed joints.
3. Flush vertical joints full with mortar.
4. Leave all joints with exposed tops or under relieving angles open for sealant.
5. Leave head joints in copings and projecting components open for sealant.

C. LOCATION OF JOINTS

1. As shown on shop drawings.
2. At control and expansion joints unless otherwise shown.

3.4 SETTING

- A. GENERAL – Install/set all units and accessories accurately, using skilled, experienced personnel, according to approved shop and setting drawings. Use stone-fitters to perform field-cutting with power saws, when required.
1. Clean stone surfaces before setting, using only water or mild cleaning compounds containing no caustic or abrasives.
 2. Drench all stone units thoroughly with water just before setting.
 3. Provide chases, reveals, openings, and other spaces required to accommodate other

- work. Close up after other work is complete with cast stone which matches stone already set.
4. Where an open cavity is indicated between cast stone and backup material, keep cavity free of mortar and grout.
 5. Install anchors, supports, fasteners, and other attachments indicated or necessary, to secure stonework in place. Attach anchors securely to stone and to supporting surfaces. Place anchors and dowels firmly and fill holes with mortar or non-shrink grout.
 6. Set cast stone accurately, in patterns and locations indicated, with uniform joints of dimensions indicated, and with edges and faces aligned according to established relationships and indicated tolerances.
 7. Shim and adjust anchors, supports, and accessories.
 8. Set stones supported on solid structural members on setting buttons, shims, or sheets, or a combination of setting buttons, and mortar.
 9. After setting each stone, rake all joints; sponge off mortar smears and splashes.
 10. Embed only ends of lugged sills and similar stones; leave remainder of joint open and tuckpoint on faces only.
 11. Set all partially or fully horizontal stones with unfilled vertical joints. After setting, install backer rod, prime ends and caulk.

B. SETTING TOLERANCES – Set cast stone units to the following tolerances, unless detailed otherwise:

1. Variation from plumb of lines and surfaces of columns, walls, and arises:
 - a. Maximum $\frac{1}{4}$ " in 10 ft.; $\frac{3}{8}$ " in a maximum story height of 20 ft.; maximum $\frac{1}{2}$ " in any length over 40 ft.
2. Variation from level of grades indicated for floors, exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines:
 - a. Maximum $\frac{1}{2}$ " in any bay of 20 ft.; maximum $\frac{3}{4}$ " in any dimension over 40 ft.
3. Variation of linear building lines from position in plan:
 - a. Maximum $\frac{1}{2}$ " in any 20 ft. bay; maximum $\frac{3}{4}$ " in any dimension over 40 ft.
4. Variation in cross-sectional dimensions of column and wall thickness:
 - a. From dimensions indicated, maximum minus $\frac{1}{4}$ " to plus $\frac{1}{2}$ ".
5. Variation between faces of adjacent pieces and panels is not permitted.

3.5 FIELD QUALITY CONTROL

- A. INSPECTION – Verify that on-going and completed cast stone work meets specified tolerance and appearance requirements. Remove and replace work that is broken, chipped, stained, or otherwise damaged; work that does not match approved samples and work containing defective joints.
1. Replace unacceptable materials using methods and procedures approved by the cast stone manufacturer, which leaves no visible evidence of replacement.
- B. ACCEPTABLE APPEARANCE – Cast Stone shall show no obvious repairs or imperfections, other than minimal color variations, when viewed with the unaided eye at a 20 ft. distance in normal daylight conditions.

3.6 CLEANING

- A. GENERAL – Perform final cleaning as soon as possible after mortar has set and been tooled. Clean faces of stone at pointed joints immediately. Remove soiled areas,

streaks and stains from prefinished panels using clean water and soft bristle brush, followed by clear water rinse.

- B. Use no wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials, or methods which could damage, discoloration, etching of surfaces or joints, without written approval from cast stone manufacturer.

- 3.7 PROTECTION – Protect work from staining or damage to finished surfaces by on-going construction, until acceptance by the Owner.

END OF SECTION 04 7200

DIVISION 05 – METALS

SECTION 05 5000 – METAL FABRICATIONS

1. GENERAL

- 1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.
- 1.2 SCOPE – Furnish all labor, material and equipment required to complete Metal Fabrications Work shown on the drawings, as detailed, and as herein specified. The Contractor will be responsible for all work reasonably required under this SECTION Specification Heading.

See Design Data on the Drawings.

Work involved under this SECTION shall include, but not necessarily be limited to, the following items:

- A. Custom fabricated steel coping.
 - B. Steel Pipe Handrails.
 - C. Shop prime painting.
 - D. Submittals.
- 1.3 SUBMITTALS – The fabricator shall prepare and submit for approval, detailed shop drawings for all fabricated items and receive approval before starting fabrication. Submission shall be in accordance with SECTION 01 3300 – SUBMITTAL REQUIREMENTS.

2. PRODUCTS

2.1 GENERAL MATERIALS

- A. Steel – For rolled shapes, plates and bars shall conform to the ASTM 36.
- B. Cast Iron – Shall conform to ASTM 48.
- C. Steel Pipe – Shall be seamless black steel pipe conforming to ASTM 53.
- D. Aluminum – Shall be 6063-T5 Alloy mill finish bar extrusions, angles, etc.
- E. Stainless Steel – Type 316.

2.2 STEEL PIPE HANDRAILS

- A. Handrails – At interior stairs shall be formed from 1 ½” diameter steel pipe with integral brackets. Complete with anchors, bolts, sleeves, etc. for a complete assembly as shown on the drawings.

3. EXECUTION

- 3.1 FABRICATION – Work shall be smooth, unblemished and free from defects, impairing strength, durability and appearance. All work shall be fabricated in accordance with the best practice of the trade, in accordance with the manufacturer's standard details and

complete in every respect. The manufacturer shall check the shop drawings before submission to the Architect.

- 3.2 INSTALLATION – Shall be first-class by experienced mechanics in accordance with the best practice of the trade and manufacturer's recommendations. Protect all work until building is ready for occupancy.

END OF SECTION 05 5000

DIVISION 05 – METALS

SECTION 05 5133 – METAL LADDERS

1. GENERAL

- 1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.
- 1.2 SCOPE – Furnish all labor, materials, and equipment to complete all Metal Ladder Work as shown on the drawings or herein specified. The Contractor will be responsible for providing all work that is reasonably required under this SECTION Specification Heading.

The work involved under this SECTION shall include, but not necessarily be limited to, the following:

- A. Aluminum Ladders.
- B. Shop Drawings.

1.3 SUBMITTALS

- A. PRODUCT DATA – For ladders and accessories specified, include manufacturer's specifications and installation instructions.
- B. SHOP DRAWINGS – Submit detailed shop drawings showing sizes, materials, sections, hardware, etc. and samples for approval in accordance with SECTION 01 3300 – SUBMITTAL REQUIREMENTS.

2. PRODUCTS

- 2.1 APPROVED MODEL & MANUFACTURERS – Shall be Model FL, by Precision Ladders LLC, or approved equal.
- 2.2 ALUMINUM LADDERS –
- A. Aluminum Ladder:
 - 1. Capacity: Unit shall support a 1,000 lb loading without failure.
 - 2. Performance Standard: Units designed and manufactured to meet or exceed ANSI A14.3 and OSHA 1910.27.
 - B. Components:
 - 1. Ladder Stringer: 2 ½" x 1 1/16" x 1/8" extruded 6005-T5 aluminum channel, extend 42" minimum above top of roof edge.
 - 2. Ladder Tread: 2 ¼" x ¾" x ¼" extruded 6005-T5 aluminum with deeply serrated top surface.
 - 3. Ladder Mounting Bracket: 8 ½" x 2" x 3" x ¼" thick aluminum angle.
 - 4. Finish: Mill finish on all aluminum ladder components.

2.3 FABRICATION – Completely fabricate ladder ready for installation before shipment to the site.

3. EXECUTION

3.1 EXAMINATION – Examine materials upon arrival at site. Notify the carrier and manufacturer of any damage.

3.2 INSTALLATION – Install in accordance with manufacturer's instructions.

3.3 PROTECTION

A. Protect installed products until completion of project.

END OF SECTION 05 5133

DIVISION 06 – WOODS, PLASTICS, AND COMPOSITES

SECTION 06 1000 – ROUGH CARPENTRY

1. GENERAL

- 1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.
- 1.2 SCOPE – Furnish all labor, material and equipment necessary to complete all Rough Carpentry Work as called for on the drawings, as detailed, as required and as specified herein. Furnish and install all rough hardware, nails, bolts, screws, toggle bolts, expansion bolts, etc., as necessary. The Contractor will be responsible for all work reasonably required under this SECTION Specification Heading.

Work involved under this SECTION shall include, but not necessarily be limited to, the following items:

- A. Exterior and interior wall framing, beams, and headers.
- B. Engineered lumber beams and headers.
- C. Pre-engineered roof trusses.
- D. O.S.B. roof deck and wall sheathing.
- E. Miscellaneous wood framing, blocking, and nailers as shown on the drawings and required.
- F. All Rough Hardware.
- G. Treated wood framing, blocking, and nailers as shown on the drawings.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Form Work – SECTION 03 3000 – CAST-IN-PLACE CONCRETE.
- B. Finish Carpentry – SECTION 06 2000 – FINISH CARPENTRY.
- C. Cabinetry – SECTION 06 4100 – ARCHITECTURAL WOOD CASEWORK.

2. PRODUCTS

2.1 LUMBER

- A. GENERAL:
- 1. Factory-Mark each piece of lumber with type, grade, mill, and grading agency, except omit marking from surfaces to be exposed with transparent finish or without finish.
 - 2. Nominal Sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use.
 - 3. Provide Dressed Lumber, Douglas Fir Larch (DFL), No. 2 or better, unless otherwise indicated.
 - 4. Provide Seasoned Lumber with 19% maximum moisture content at time of dressing unless shown or specified to receive wood preservative treatment.

- B. WOOD BLOCKING & NAILERS – Blocking, nailers, plates, furring, and other non-structural framing shall be Spruce Pine Fir (SPF), Construction/Stud Grade, or other species/grades under WWPAA rules and standards with equal or greater properties.
- C. FRAMING LUMBER
 - 1. Dimensional Structural Lumber Framing – Shall be Douglas-Fir-Larch (DFL), No. 2 or better grade, or other species/grades under WWPAA rules and standards with equal or greater properties.
 - 2. Light Lumber Framing including: all non-load bearing interior partition walls, blocking, nailers, plates, furring, and other non-structural framing shall be Spruce Pine Fir (SPF), Construction/Stud Grade, or other species/grades under WWPAA rules and standards with equal or greater properties.
 - 3. Optional Framing – In lieu of dimensional lumber, engineered wood products may be used. Engineered wood products must provide for the required loads. Submit documentation according to SECTION 01 3300 – SUBMITTAL REQUIREMENTS, to substantiate load carrying requirements.

2.2 ENGINEERED LUMBER

- A. Engineered Beams and Headers – Shall be by Trus Joist MacMillan, or approved equal.
 - 1. Microllam LVL: 1.9E
 - 2. Parallam PSL: 2.0E
 - 3. TimberStrand LSL: 1.3E
 - 4. TimberStrand LSL Beam: 1.55E

Beams and headers shall provide for the required loads indicated on the drawings.
Provide minimum bearing per manufacturer's requirements.

- B. Engineered Joists – TJI/Pro by Trus Joist MacMillan, or approved equal. Size to provide for the required loads indicated on the drawings. Provide minimum bearing and connections per manufacturer's requirements.
- C. All engineered lumber shall contain no added urea-formaldehyde resins.

2.3 PRE-ENGINEERED ROOF TRUSSES

- A. All lumber used in the design of wood trusses shall be kiln dried and graded in accordance with the current grading rules. Design stresses allowed are those listed in the current editions of the respective Lumber Association's grading rules.
 - 1. Top Chord: No. 1 or better SYP.
 - 2. Bottom Chord: 1950 MSR or better SPF.
 - 3. Webs: No. 1 or better SYP.
- B. The design of wood members shall be in accordance with the formulas published in the current edition of the National Design Specification for Wood Construction.
- C. Light metal toothed connector plates and joint design shall conform to specifications as set forth in the current edition of Truss Plate Institute's Design Specification for Metal Plate Connected Wood Trusses. Connector plates shall be fabricated from ASTM A653, Grade A, galvanized with a G90 coating.

- D. Design and fabricate trusses and connections to withstand snow, wind, and dead loads.
 - E. Fabricate trusses in plant, using mechanical or hydraulic fixtures as required to bring members in contact. Install plates in accordance with manufacturer's instructions.
- 2.4 SHEATHING – Each panel shall be equal to grades/ratings of the American Plywood Association as later specified. Panel thickness shall be as shown on the drawings or specified. All sheathing shall contain no added urea-formaldehyde resins.
- 1. Plywood – APA rated sheathing, span rating of 24/16, exposure 1.
 - 2. Oriented Strand Board (O.S.B.) – APA rated sheathing, span rating of 24/16, exposure 1.
- Roof sheathing shall have aluminum pyclicks.
- 2.5 WOOD PRESERVATIVE – Any wood cast into concrete, or placed against concrete floors, and any other wood noted as "treated" shall be pressure treated with Alkaline Copper Quat (ACQ) or Copper Azole (CA) preservatives.
- 2.6 ANCHORS AND FASTENERS – Shall be equal to those manufactured by Buildex such as TAPCON or TEKS and as distributed by Iowa Industrial Products Co. of Des Moines, IA; expansion bolt equal to WEJ-IT as manufactured by WEJ-IT Corp. of Bloomfield, CO, or other units suited to the application as detailed and as approved by the Architect.
- 2.7 ANCHORS AND FASTENERS AT TREATED LUMBER – Shall be galvanized treated to provide corrosion protection. Fasteners and anchors shall comply with the following standards: ASTM A653, ASTM A123, and ASTM A153.

3. EXECUTION

3.1 WORKMANSHIP

- A. Install all work in this SECTION plumb, level, true and square to dimensions shown. Allow for finish as required. All work shall be in keeping with the best standard practice of the industry and shall be done by competent mechanics skilled in their trade. Rough carpentry shall comply with the applicable Sections of Chapter 23, IBC.
- B. All framing shall have sound bearing, square cuts with full bearing surfaces. Anchor in a substantial manner to hold dimensions required. Block and shim where necessary. Use metal anchors as detailed or required for proper fastening.
- C. Any wood blocking set against or buried in concrete and elsewhere as noted shall have wood preservative treatment.

3.2 GENERAL

- A. Use only new materials free from warpage which can be corrected permanently by anchoring and attachment. Install fasteners without splitting wood (predrill as required). Nails shall penetrate into wood members a minimum of 1" (2.5 cm).
- B. WALLS – Frame double top plate on load bearing walls, single plate on non-load bearing partitions. Provide single sole and sill plates (treated as required). Double jamb studs

and provide minimum bearing of one stud for headers. Triple studs at outside corner and partition to partition intersection. Anchor sole plate to foundation with minimum of ½" diameter bolts extending into concrete 15". Provide minimum two (2) anchors per piece of wood spaced 4'-0" o.c. and 12" from end of plate.

C. SHEATHING

1. Wall Sheathing – Allow 1/8" spacing at panel ends and ¼" at panel edges or as recommended by panel manufacturer. Nail 6" o.c. along panel edges and 12" o.c. at intermediate supports with 8d nails.
2. Roof Sheathing – Install with long edges across supports and continuous across two or more spans. Provide edge supports by use of aluminum panel clips and lumber blocking between chords. Panel end joints shall occur over framing. Nail 6" o.c. along panel edges and 12" o.c. at intermediate supports with 8d nails. **NAILS THAT MISS FRAMING SUPPORTS MUST BE RE-DONE.**

D. WOOD BLOCKING AT ROOF EDGE, CURBS AND FLASHINGS

1. Install all wood blocking, plates, cants, etc. plumb, level, true and square to dimensions shown. All work, including fasteners, shall be in keeping with the best standard practice of the industry and shall be done by competent mechanics skilled in their trade.
 2. Anchor in a substantial manner as detailed or as approved by the Owner's Representative to resist force of 75#/LF in any direction. Block and shim where necessary. Use metal anchors as detailed or required for proper fastening. Fasteners and anchors shall not be countersunk to exceed ½" or ½ the thickness of the wood, whichever is less. Nail blocking together with a minimum of 16d coated nails @ 16" o.c.
 3. Fill under blocking where required with grout before installing wood blocking.
- 3.3 FASTENERS – Install all fasteners, anchors, and hanger according to manufacturer's recommendations and instructions.
- 3.4 BRIDGING – Furnish and install joist bridging according to manufacturer's recommendations and instructions.
- 3.5 PROTECTION – Protect all lumber and other materials at the job site from exposure to moisture and weather.

END OF SECTION 06 1000

DIVISION 06 – WOODS, PLASTICS, AND COMPOSITES

SECTION 06 2000 – FINISH CARPENTRY

1. GENERAL

- 1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.
- 1.2 SCOPE – Furnish all labor, materials and equipment to complete, ready for painting or finishing, all Finish Carpentry Work as shown on the drawings and as herein specified. The Contractor will be responsible for all work reasonably required under this SECTION Specification Heading. This SECTION shall include all carpentry work not included in SECTION 06 1000 – ROUGH CARPENTRY.

Work involved under this SECTION shall include, but not necessarily be limited to, the following items:

- A. Fitting and hanging of wood doors.
- B. Installation of all Finish Hardware.
- C. Wood window sills.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Other Carpentry – SECTION 06 1000 – ROUGH CARPENTRY.
 - B. Furnishing of Wood Doors – SECTION 08 1400 – WOOD DOORS.
 - C. Finish Hardware – SECTION 08 7100 – DOOR HARDWARE.
 - D. Wood Trim Finishing – SECTION 09 9000 – PAINTING.
- 1.4 SUBMITTALS – Submit shop drawings on all millwork, etc., showing all details of construction and co-ordination with other items of work, in accordance with SECTION 01 3300 – SUBMITTAL REQUIREMENTS.
- 1.5 SAMPLES – Submit samples of wood and plastic laminate for selection by the Owner's Representative. Do not proceed with ordering until samples are approved.
- 1.6 GUARANTEE – All finish carpentry work and millwork shall be guaranteed against warping, racking, shrinkage, and other defects for a period of one (1) year from final acceptance of the building.

2. PRODUCTS

2.1 MATERIALS

- A. MATERIALS AND FABRICATION – Shall be custom grade for transparent finish in accordance with AWI "Quality Standards Illustrated".
- B. LUMBER – Shall be commercially dried to moisture content recommended by Forest Products LA., Madison, WI.

C. INTERIOR TRIM AND MILLWORK – Shall be as specified below unless otherwise noted:

1. Exposed solid wood – Maple, plain sliced.
2. Semi-exposed solid wood – Maple, plain sliced.
3. Concealed solid wood – at option of mill.
4. Exposed plywood – Maple, plain sliced veneer.
5. Semi-exposed plywood – Maple, plain sliced veneer.
6. Concealed plywood – at option of mill.

All plywood shall contain no added urea-formaldehyde resins.

D. SUSPENDED PLYWOOD CEILING/SOFFIT – Shall be APA rated, span rating 24/16 minimum, A Clear or Better Cedar Veneer, exposure 1, thickness as shown on the drawings. Plywood ceiling/soffit shall contain no added urea-formaldehyde resins.

2.2 FABRICATION AND MANUFACTURE

- A. All work shall be preformed in accordance with reference standards, thoroughly smooth, sanded, scraped and prepared for finishing and shall be free from machine or tool marks, abrasions, raised grain, slivers, etc. All moldings shall be struck clean and smooth in accordance with details, and shall be bradded in quirks with all nails set for putty fill. Drill holes for nails to prevent splitting. Joints shall be absolutely tight and all work shall be plumb, square, level and true.
- B. Trim shall be furnished in single pieces for lengths up to 16" and shall not be over two (2) pieces where longer lengths are required. Splices shall be bevel cut, glued, and nailed. See Room Finish Schedule and Trim Details.

3. EXECUTION

- 3.1 INSPECTION – Examine all grounds, stripping, and blocking to secure millwork, trim, etc. Do not install millwork until all defects are corrected.
- 3.2 INSTALLATION OF WOOD TRIM – Standing and running trim shall be installed in single lengths except where splices are permitted in running trim. Splices shall be located only where solid fastenings can be made. Cope molded work at returns and interior angles. Miter at corners.
- 3.3 INSTALLATION OF WOOD DOORS AND FINISH HARDWARE – Wood doors, Finish hardware for any doors, miscellaneous wood finish work, etc., of whatever nature, shall be carefully installed by skilled finish carpenters. Fit hardware before painter's finish is applied and then remove. After painter has completed his work, replace all hardware. Properly label and deliver keys to Owner.
- 3.4 ADJUST AND CLEAN – Provide protection necessary for all millwork to prevent damage prior to acceptance. Remove and replace any damaged or defective millwork at no extra costs to Owner.

END OF SECTION 06 2000

DIVISION 06 – WOODS, PLASTICS, AND COMPOSITES

SECTION 06 4100 – ARCHITECTURAL WOOD CASEWORK

1. GENERAL

1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.

1.2 SCOPE – Furnish all labor, materials, and equipment to complete, all Architectural Plastic Laminate and Wood Casework as shown on the drawings and as herein specified. The Contractor will be responsible for all work reasonably required under this SECTION Specification Heading.

Work involved under this SECTION shall include, but not necessarily be limited to, the following items:

- A. Plastic laminate covered cabinets, countertops, and splashes.
- B. Shelving, brackets, clips, and standards.
- C. Rough Hardware for securing, fastening, and installation.
- D. Finished Hardware for casework.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Other Carpentry – SECTION 06 1000 – ROUGH CARPENTRY.
- B. Other Carpentry – SECTION 06 2000 – FINISH CARPENTRY.

1.4 SUBMITTALS – Submit shop drawings on all millwork, etc., showing all details of construction, machined profiles, materials and finishes, hardware, and coordination with other items of work, in accordance with SECTION 01 3300 – SUBMITTAL REQUIREMENTS.

1.5 SAMPLES – If requested, submit samples of wood and plastic laminate for selection by the Architect. Do not proceed with ordering until samples are approved.

1.6 GUARANTEE – All finish carpentry work and millwork shall be guaranteed against warping, racking, shrinkage, and other defects for a period of one (1) year from final acceptance of the building.

1.7 COMPLIANCE WITH STANDARD AND INDUSTRY SPECIFICATIONS – Any materials or operation specified by reference to the published specifications of a manufacturer, the Architectural Woodwork Institute (AWI), National Lumber Manufacturer's Association (NLMA), Douglas Fir Plywood Association (DFPA), Hardwood Plywood Institute (HPI), National Door Manufacturer's Association (NDMA) Underwriter's Laboratories, Inc. (UL), or other published standards shall comply with the requirements of the standards listed.

In case of conflict between the referenced specifications and the project specifications, the project specifications shall govern.

In case of conflict among the referenced specifications or standards, the one having the

more stringent requirements shall govern.

2. PRODUCTS

2.1 PLASTIC LAMINATE

- A. PLASTIC LAMINATE – Horizontal and vertical surfaces, countertops and edges, shall be NEMA General Purpose Type, nominal 0.050" thickness. Plastic Laminate shall be Wilsonart, Formica, or approved equal. All fabricating and manufacturing shall equal or exceed the recommendations of the National Association of Plastic Fabricators for the product application. The supplier shall furnish all required accessories and special features, such as; end caps, end splashes, etc. for a totally complete installation in keeping with the best standards of the industry. Backing/balance sheet shall be applied to underside of all countertops. Particle board base materials shall be high density (45 lbs./ft.³ or greater) material.

2.2 PLASTIC LAMINATE CASEWORK

- A. Cabinet Construction
 - 1. Shall be Frameless.
 - 2. Details shall conform to Reveal Overlay
- B. Casework Bodies – ¾" particle board, conforming to ANSI A208, Type M-3 with White pressure fused laminate interior surfaces conforming to NEMA LD3.3 GP28. Cabinet body joints to be either dadoed, glued, and screwed or doweled and screwed. Cabinet backs to be minimum 3/8" thick, and to be recessed 7/8" from rear and dadoed into sides, top, and bottom four sides, supported with ¾" structural stiffeners, and sealed with hot melt glue at perimeter. All wall cabinet top and bottom members are to be 1" thick.
- C. Exterior Surfaces – Wall cabinet bottoms to receive White pressure fused laminate surfaces, all other exterior cabinet surfaces to be NEMA LD3 GP28 .030" thick vertical grade high pressure plastic laminate balanced with a minimum .020" cabinet liner. All plastic laminates to be applied with hybrid PVA Type III water resistant adhesives. Cabinet body edges to be 1mm PVC machine applied with hot melt adhesive, trimmed, and buffed.
- D. Doors – ¾" thick particleboard with vertical grade laminate exterior and .020" cabinet liner interior applied with PVA adhesive for a total door thickness of 13/16". Door and drawer edges to be 3 mm PVC. Solid, high impact, purified, color-thru, acid resistant, pre-lamination primed edging, machine-applied with hot melt adhesives, automatically trimmed, inside/outside length-radiused for uniform appearance, buffed and corner-radiused for consistent design.
- E. Drawers – 5/8" thick hardwood box construction, faced and balanced or sealed, joints glued and doweled or lock shoulder dadoed and glued, mechanically fastened with ¼" masonite bottoms. Bottoms to be recessed and dadoed all sides with stiffener. All exposed surfaces of unfaced wood to be shop sealed with two (2) coats polyurethane varnish. Alternate construction consisting of drawer body material of multi-directional fiberboard conforming to ANSI A208.2 with White pressure fused laminate surface with bottom recessed, captured all four sides and sealed with hot melt adhesive. Provide under body stiffener. Drawers provided under this Alternate construction must be

provided with independent laboratory testing certifying front joint load of 615 lbs. and static load of 635 lbs. when loaded at the drawer bottom. Particleboard bodies and/or surface applied bottoms are not acceptable.

- F. Adjustable Shelves – Concealed and Exposed – $\frac{3}{4}$ " thick at shelves up to 27" wide, 1" thick over 27" wide, laminated with melamine (standard color as selected by Architect), 1 mm PVC edges, heavy duty plastic shelf supports, or approved equal.

2.3 HARDWARE AND MISCELLANEOUS

A. Hardware

1. Shelf Supports – Heavy-duty metal flat top shelf support pins.
2. Pulls – Shall be 4" painted aluminum wire pulls by Stanley, or approved equal. Standard color to be selected by Architect.
3. Hinges – Shall be Blum compact concealed 170 degrees self-closing hinges, or approved equal.
4. Door Soft Close – Blumotion 971A by Blum, or approved equal. Install one (1) per cabinet door.
5. Drawer Slides – Shall be Tandem plus Blumotion by Blum, or approved equal. 150 pound rated, heavy duty, full extension slides with soft close mechanism.
6. Locks – Shall be KL1000 Classic KitLock by Codelocks.
7. Coat Hooks – Shall be Zinc Nickel Plated Double Point Hook, screw mount, with (2) hooks (Zoro #G2314794 or equal). Install (2) sets of hooks in each open locker.

- B. Sub-Base – Separate and continuous sub-base of $\frac{3}{4}$ " thick water-resistant plywood. Cabinet sides to floor will not be accepted.

- C. Countertops – Shall have post-formed edges, unless otherwise noted on the drawings.

- D. Splashes – Shall have square edges, unless otherwise noted on the drawings.

- E. Interior Liners (cabinets, doors, drawers, shelves) – Shall be laminated with melamine, standard color as selected by Architect.

- F. Countertop Support Brackets – A&M Hardware, Inc., steel brackets or approved equal. Standard color as selected by Architect.

2.4 EXPOSED ADJUSTABLE WALL SHELVES

- A. Shelves shall be $\frac{3}{4}$ " thick particle board with melamine covering horizontal surfaces and 1mm PVC at all edges. Color as selected by the Architect from manufacturer's standard colors.

- B. Pilaster Standards shall be No. 87 by Knappe & Vogt, or approved equal. Titanium finish.

- C. Brackets shall be No. 187LL by Knappe & Vogt, or approved equal. 12" shelf, titanium finish.

2.5 MILLWORK FABRICATION – All wood finish and millwork shall be true to details, clean and sharply defined. Means of fastening parts together shall be concealed.

Workmanship shall be of the highest quality by experienced craftsmen. Wood casework shall meet or exceed AWI 400A Custom Grade. Plastic laminate clad casework shall meet or exceed AWI 400B Custom Grade. Countertops shall meet or exceed AWI 400C Custom Grade.

3. EXECUTION

3.1 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify mechanical, electrical, and building items affecting work of this section are in place and ready to receive this work.

3.2 INSTALLATION

- A. Install work in accordance with Custom Grade, Section 1700, QSI.
- B. Set and secure materials and components in place, plumb and level.

3.3 ADJUSTING

- A. Adjust work as required for proper alignment.
- B. Adjust moving or operating parts to function smoothly and correctly.

3.4 CLEANING – Clean work under provisions of Section 01 7000 of the project manual.

END OF SECTION 06 4100

**SECTION 07 1000
DAMPPROOFING AND WATERPROOFING**

1. GENERAL

- 1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.
- 1.2 SCOPE – Furnish all labor, materials and equipment to complete all Dampproofing and Waterproofing Work, as indicated on the drawings and as herein specified. The Contractor will be responsible for providing all work reasonably required under this SECTION Specification Heading.

The work involved under this SECTION shall include but not necessarily be limited to, the following:

- A. Mastic waterproofing on exterior foundation walls.
- 1.3 SUBMITTALS – Submit shop drawings on all waterproofing, showing all details of construction and co-ordination with other items of work, in accordance with SECTION 01 3300 – SUBMITTAL REQUIREMENTS.

2. PRODUCTS

- 2.1 TROWELLED-ON MASTIC WATERPROOFING – Shall be HLM 5000T by Sonneborn, or approved equal.

3. EXECUTION

- 3.1 MASTIC WATERPROOFING – Shall be as specified, applied in strict accordance with the manufacturer's directions, trowelled on to a full and uniform thickness 60 wet mil, (45 dry mil) in areas shown on the drawings.
- A. PROTECTION – Protect completed membrane during installation of other materials or processes. Do not allow traffic on unprotected membrane.

END OF SECTION 07 1000

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

SECTION 07 2000 – THERMAL PROTECTION

1. GENERAL

- 1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.
- 1.2 SCOPE – Furnish all labor, materials and equipment required to complete all Thermal Protection Work shown on the drawings, as detailed, and as herein specified. The Contractor will be responsible for providing all insulation work reasonably required under this Section Specification Heading for the project that is not specified elsewhere in other SECTIONS.

Work under this SECTION shall include, but not necessarily be limited to, the following items:

- A. Rigid insulation board at perimeters of foundation walls.
- B. Rigid insulation board thermal breaks.
- C. Batt insulation.
- D. Sound batt insulation.
- E. Blown attic insulation.
- F. Rigid insulation board wall sheathing.
- G. Submittals

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Rigid roof insulation – SECTION 07 5324 – ADHERED ELASTOMERIC MEMBRANE ROOFING.
- B. EIFS – SECTION 07 2400 – EXTERIOR INSULATION AND FINISH SYSTEMS

2. PRODUCTS

2.1 MATERIALS

- A. RIGID INSULATION BOARD – For building perimeter at foundation walls, slab thermal breaks, under concrete slab, and wall sheathing shall be expanded polystyrene ACH Foam Technologies – Foam Control Plus 250, or approved equal, with the following properties:
- 1. R-Value: 4.4 per 1" @ 75 degrees F. mean temperature, ASTM C518.
 - 2. Compressive Strength: 25 psi min., ASTM D1621.
 - 3. Flexural Strength: 75 psi min., ASTM 6203.
 - 4. Water Absorption: 2.0% max., by volume, ASTM C272.
 - 5. Water Vapor Permeance: 2.5 max. perm., ASTM E96.

Thicknesses as shown on the drawings.

- B. EXPANDED POLYSTYRENE RIGID INSULATION BOARD – continuous wall insulation

shall have thicknesses in accordance with the drawings and have the following properties:

1. R-value of 4.2 @ 75 degrees mean temperature.
2. Density of 1.8 lb./cu. ft.
3. Water absorption of 2.0 percent when tested in accordance with ASTM C272.
4. Water vapor permeability of 2.0 perms when tested in accordance with ASTM E96.

Approved manufacturers or suppliers include:

Iowa EPS Products, Inc., Indianola, IA.
Minnesota Diversified Products, Inc., Rockford, MN.

- C. BATT INSULATION – Shall be Certainteed, Owens Corning, or approved equal, light density unfaced thermal friction fit fiberglass insulation. See the drawings for required thicknesses and/or R-values.
- D. SOUND ATTENUATION BLANKETS – Shall be Thermafiber (3 ½” thick semi-rigid spun mineral fiber mat), Owens Corning Sound Attenuation Batts (3 ½” thick fiberglass insulation batts), or approved equal.
- E. BLOWN ATTIC INSULATION – Shall be Owens Corning-Atticat loosefill fiberglass insulation. The insulation shall comply with ASTM C764, C687, E136, C764 section 12.7, C1104, and C1338. Reference the drawings for thicknesses and/or R-Values. Thicknesses designated on the drawings are settled thicknesses.

- 2.2 PROTECTION – Protect all materials at the job site from exposure to moisture and weather.

3. EXECUTION

- 3.1 WORKMANSHIP – All work shall be in keeping with the best standards in the industry and will be done by mechanics competent and skilled in their trade.

3.2 INSULATION

- A. RIGID PERIMETER FOUNDATION INSULATION – Install where shown on the drawings with beads of mastic as recommended by the manufacturer before backfilling.
- B. SLAB THERMAL BREAK – Isolate all interior concrete floor slabs from exterior platform slabs with rigid insulation, continuous under thresholds and sidelights.
- C. PLATFORM SLAB INSULATION – Will be installed directly under the slab.
- D. RIGID INSULATION WALL SHEATHING – Shall be installed to the exterior side of the building as shown on the drawings. Fasten according to manufacturer's recommendations.
- E. BATT INSULATION
 1. Walls – Install of width sufficient to fully fill stud spaces as specified and provide appropriate manufacturer recommended intermediate vertical support as required to prevent sagging and settlement of the stud space insulation. All joints and seams will be tightly fit.

2. Attic – Insulation installation shall be a two (2) layer application. The lower layer will be applied between the lower chords of the roof trusses, fully filling the space. The upper layer will be applied on top of, and perpendicular to, the lower chords to the roof trusses. The insulation batts shall fit tightly together and shall be cut to tightly fit around all structural members, walls, draftstops, and other attic penetrations.
 3. Air gaps in the batt insulation are not allowed.
- F. SOUND ATTENUATION BLANKETS – Shall be installed in all stud spaces around and between classrooms and other rooms as designated on the drawings, to a point 8" above the adjacent ceiling line.
- G. BLOWN ATTIC INSULATION – Will be installed in full accordance with the manufacturer's recommendations for the construction contemplated on the basis of high class trade practice.
- 3.3 ALL INSULATION – Will be installed in full accordance with the manufacturer's recommendations for the construction contemplated on the basis of high class trade practice. All joints and seams will be tightly fit with joint overlap where multiple layers are used.

END OF SECTION 07 2000

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

SECTION 07 2400 – EXTERIOR INSULATION AND FINISH SYSTEMS

1. GENERAL

- 1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.
- 1.2 SCOPE – Furnish all labor, materials, and equipment required for the Exterior Insulation and Finish System Work herein, as indicated on the drawings and as required for the construction. The Contractor will be responsible for all work reasonably required under this SECTION Specification Heading.

Work under this SECTION for the Base Bid shall include, but not necessarily be limited to, the following item:

- A. Air/Moisture Barrier at EIFS walls and compatible with EIFS system.
- B. All Exterior Insulation and Finish System designated on the drawings will be STO System, is herein specified.

The Exterior Insulation and Finish System under this Section will be required at walls as shown and detailed on the drawings wherever “EIFS” designation is used.

Installation, in general, will be as follows:

- 1. Walls – Sto Finish on Base Coat on Insulation Board on Sheathing Board. Base Coat shall be embedded with both Sto Standard Mesh.
- C. Preparation of surface backing.
 - D. Color and Finish Texture Samples.
- 1.3 RELATED WORK SPECIFIED ELSEWHERE
- A. Sealants – SECTION 07 9000 – JOINT PROTECTION.
 - B. Sheathing – SECTION 06 1000 – ROUGH CARPENTRY.
- 1.4 **PERFORMANCE REQUIREMENTS**
- a. Air and Water-resistive Barrier
 - i. Air leakage less than 0.004 cfm/ft² (0.02 L/s·m²) at 1.57 psf (75 Pa) when measured in accordance with ASTM E2178
 - ii. Assembly air leakage less than 0.04 cfm/ft² (0.2 L/s·m²) after conditioning protocol when measured in accordance with ASTM E2357
 - iii. Vapor Permeable, Water vapor permeance greater than 10 perms when measured in accordance with ASTM E96, Method B
 - iv. Vapor Impermeable, Water vapor permeance less than 0.1 perms when measured in accordance with ASTM E96, Method A

- v. No water penetration when subjected to sequential water spray of 2.86 psf (137 Pa), then 6.24 psf (299 Pa), for 15 minutes at each pressure interval, when measured in accordance with ASTM E331
- vi. No water penetration at nail puncture after 72 hours at 40°F (4°C) when measured in accordance with ASTM D1970
- vii. No mold growth at 70 days when measured in accordance with ASTM D3273

b. EIFS Cladding

- i. Meets or exceeds durability requirements of ASTM E2568
- ii. Drainage efficiency greater than 95% when measured in accordance with ASTM E2273
- iii. No water penetration when subjected to 75 minutes of water spray at 6.24 psf (299 Pa) and measured in accordance with ASTM E331
- iv. No mold growth at 60 days when measured in accordance with ASTM D3273
- v. Flame spread and smoke development of lamina (base coat, reinforcing mesh, and finish) less than 25 and 450, respectively, when tested in accordance with ASTM E84
- vi. Meets acceptance criteria of NFPA 285 for use on non-combustible construction
- vii. No ignition when exposed to radiant heat in accordance with NFPA 268
- viii. Maintains hourly fire resistance rating of known, rated wall assembly when tested in accordance with ASTM E119
- ix. Meets standard impact resistance with Sto Mesh, meets Ultra-High impact resistance with Sto Mesh and Sto Armor Mat, when measured in accordance with ASTM E2486
- x. Ultimate wind load capacity of plus or minus 188 psf (9.00 kPa) when measured in accordance with ASTM E330, and support wall construction achieves equal or greater ultimate load capacity

1.5 COMPLIANCE

1.6 Air and Water-resistive Barrier

- 1.6.1 Meets or exceeds maximum allowable material air leakage requirements of the 2018 IECC based on independent laboratory testing in accordance with ASTM E2178
- 1.6.2 Meets or exceeds maximum allowable assembly air leakage requirements of the 2018 IECC based on independent laboratory testing in accordance with ASTM E2357
- 1.6.3 Meets requirements of ICC AC 212 for coatings used as WRBs over sheathing
- 1.6.4 Listed as compliant with 2018 IBC, IRC, and IECC in a current ICC-ES Evaluation Report
- 1.6.5 Meets VOC emission standard of South Coast AQMD Rule 1113 for Building Envelope Coatings

1.7 EIFS Cladding

- 1.7.1 Meets performance and weather resistance requirements of 2018 IBC Sections 1407.2 and 1407.4, and complies with requirements of Chapter 26 for use on

noncombustible construction (Types I, II, III, and IV) and in fire-resistance rated wall assemblies. Complies with requirements for use on combustible (Type V) construction.

- 1.7.2 Meets performance requirements of 2018 IRC Sections R703.9.1 and R703.9.2
- 1.7.3 Meets requirements of ICC AC 235 for EIFS clad drainage wall assembly
- 1.7.4 Listed as compliant with 2018 IBC and IRC in a current ICC-ES Evaluation Report
- 1.7.5 Textured finishes meet VOC emission standard of South Coast AQMD Rule 1113 for Architectural Coatings
- 1.7.6 Complies with 2022 New York City Building Code requirements for fireblocking

1.8 Joint Sealant for Use with EIFS

- 1.8.1 Conforms with ASTM C920: Type S, Grade NS, Use NT, A, M, Class 100/50
- 1.8.2 Meets Federal Specification TT-S-00230C Type II
- 1.8.3 Conforms with AAMA 808.3 (Type1) Exterior Perimeter Sealing

1.9 QUALITY ASSURANCE

- 1.9.1 Manufacturer Requirements
- 1.9.2 Member in good standing of the EIFS Industry Members Association (EIMA) for over thirty (30) years
- 1.9.3 Air and water-resistive barrier and EIFS manufacturer for a minimum thirty (30) years
- 1.9.4 Manufacturing facilities in compliance with ISO 9001 Certified Quality System and ISO 14001 Certified Environmental Management System

1.10 Contractor Requirements

- 1.10.1 Engaged in application of similar systems for a minimum of three (3) years
- 1.10.2 Knowledgeable in the proper use and handling of Sto materials
- 1.10.3 Employ skilled mechanics who are experienced and knowledgeable in air and water-resistive barrier and EIFS application, and familiar with the requirements of the specified work
- 1.10.4 Successful completion of minimum of three (3) projects of similar size and complexity compared to the specified project
- 1.10.5 Provide the proper equipment, manpower and supervision on the job site to install the system in compliance with Sto's published specifications and details and the project plans and specifications

1.11 Insulation Board Manufacturer Requirements

- 1.11.1 Expanded Polystyrene (EPS) insulation board listed by an approved agency and in compliance with the applicable building code
- 1.11.2 EPS board manufactured under Sto licensing agreement and EPS molder recognized by Sto as being capable of producing EPS insulation board to meet EIFS requirements

1.12 Mock-up Testing

- 1.12.1 Construct full-scale mock-up of typical air and water-resistive barrier and EIFS/window wall assembly with specified tools and materials and test air leakage, water infiltration and structural performance in accordance with ASTM E283, ASTM E331 and ASTM E330, respectively, through independent laboratory. Mock-up shall comply with requirements of project specifications. Where mock-up is tested at job site maintain approved mock-up at site as reference standard. If tested off-site accurately record construction detailing and sequencing of approved mock-up for replication during construction.
- 1.13 Inspections
 - 1.13.1 Provide independent third-party inspection where required by code or contract documents
 - 1.13.2 Conduct inspections in accordance with code requirements and contract documents
- 1.14 DELIVERY, STORAGE AND HANDLING
 - 1.14.1 Deliver all materials in their original sealed containers bearing manufacturer's name and identification of product
 - 1.14.2 Protect coatings (pail products) from freezing and temperatures in excess of 90°F (32°C). Store away from direct sunlight
 - 1.14.3 Protect portland cement-based materials (bag products) from moisture and humidity. Store under cover off the ground in a dry location
 - 1.14.4 Store gun-grade air barrier component at temperatures between 40 and 80°F (4 and 26°C), and protect from freezing, moisture, direct sunlight, and keep away from sources of ignition
 - 1.14.5 Insulation material is flammable. Keep away from flame or ignition sources, direct sun exposure, high heat, and temperatures in excess of 165°F (73.8°C)
- 1.15 PROJECT/SITE CONDITIONS
 - 1.15.1 Maintain ambient and surface temperatures above 40°F (4°C) during application and drying period, minimum 24 hours after application of air and water-resistive barrier and EIFS products
 - 1.15.2 Provide supplementary heat for installation in temperatures less than 40°F (4°C)
 - 1.15.3 Provide protection of surrounding areas and adjacent surfaces from application of products
- 1.16 COORDINATION/SCHEDULING
 - 1.16.1 Provide site grading such that the EIFS terminates above grade a minimum of 6 inches (150 mm) or as required by code
 - 1.16.2 Provide roofing and protection at roof and floor levels to prevent excess water entry to the interior or into and behind the exterior wall during construction.
 - 1.16.3 Coordinate installation of foundation waterproofing, roofing membrane, windows, doors and other wall penetrations to provide a continuously connected air and water-resistive barrier

- 1.16.4 Provide protection of rough openings before installing windows, doors, and other penetrations through the wall
- 1.16.5 Install window and door head flashing immediately after windows and doors are installed
- 1.16.6 Install diverter flashings wherever water can enter the wall assembly to direct water to the exterior
- 1.16.7 Install splices or tie-ins from air and water-resistive barrier over back leg of flashings, and similar details, to form a shingle lap that directs water to the exterior
- 1.16.8 Install copings and sealant immediately after installation of the EIFS when coatings are dry, and such that, where sealant is applied against the EIFS surface, it is applied against the base coat or primed base coat surface
- 1.16.9 Schedule work such that the air and water-resistive barrier is exposed to weather no longer than 180 days
- 1.16.10 Attach penetrations through the EIFS to structural support and provide watertight seal at penetrations

1.17 WARRANTY

- 1.17.1 Provide manufacturer's standard warranty

2 PRODUCTS

2.1 MANUFACTURERS

- 2.1.1 Provide air and water-resistive barrier and EIFS cladding components from single source manufacturer or approved supplier
- 2.1.2 The following are acceptable manufacturers:
- 2.1.3 Sto Corp. – Air and water-resistive barrier, EIFS Cladding, EIFS Accessories
 - 2.1.3.1 Sto Corp., 3800 Camp Creek Parkway, Building 1400, Suite 120, Atlanta, GA 30331
 - 2.1.3.2 Tel: 800 221 2397, www.stocorp.com
- 2.1.4 EPS Insulation Board – Sto licensed EPS Board molder (contact Sto Corp. for a list of licensed molders)

2.2 AIR AND WATER-RESISTIVE BARRIER

- 2.2.1 StoGuard Detail Components
- 2.2.2 Sheathing Joint Treatment, Rough Opening (RO) Protection, Counterflashing, and Penetrations:
 - 2.2.2.1 Sto Gold Coat, Sto AirSeal, or StoGuard VaporSeal: brush, spray or roller applied air and water-resistive barrier coating used with StoGuard Fabric reinforcement
 - 2.2.2.2 Sto RapidGuard: single component rapid drying gun-applied STPE detail component

2.2.2.3 Sto Gold Fill: trowel applied detail component used with StoGuard Mesh, glass fiber self-stick reinforcing mesh

2.2.2.4 StoGuard Conformable Membrane – self-adhered membrane flashing for use over prepared vertical above-grade concrete, concrete masonry, brick masonry, wood sheathing, glass mat gypsum sheathing, and cementitious sheathing

2.2.3 Air and Water-resistive Barrier Coating

2.2.3.1 Sto Gold Coat: ready mixed vapor permeable air and water-resistive barrier coating applied

2.2.3.1.1 By substrate as follows: Plywood: apply one coat at minimum 10 mils WFT

2.3 INSULATION ADHESIVE

2.3.1 Sto one component polyurethane spray foam adhesive

2.4 INSULATION BOARD

2.4.1 Expanded Polystyrene Insulation Board

2.4.2 Sto EPS Insulation Board: nominal 1.0 lb/ft³ (16 kg/m³) Expanded Polystyrene (EPS) rigid foam plastic insulation board in compliance with ASTM E2430 and ASTM C578 Type I requirements, R-3.6 per inch (RSI – 0.63 per 25mm), listed, labeled, and furnished in accordance with Section 1.7C.

2.5 BASE COAT

2.5.1 Sto factory blended one-component polymer modified portland cement base coats: Sto BTS Plus

2.6 REINFORCING MESHES

2.6.1 Open weave glass fiber reinforcing meshes treated for compatibility with Sto materials

2.6.2 Sto Mesh – nominal 4.5 oz/yd² (153 g/m²) for areas requiring standard impact resistance

2.6.3 Sto Armor Mat – nominal 15 oz/yd² (509 g/m²) for areas requiring ultra-high impact resistance at areas designated on drawings.

2.7 FINISHES

2.7.1 EIFS Color “A” – Greek Villa (SW 7551)

2.7.2 EIFS Color “B” - Brick Pattern shall be StoCast Brick Savanna S9.7341

2.7.3 Grout Color: Grey 2060

2.8 JOB MIXED INGREDIENTS

2.8.1 Water – clean and potable

2.8.2 Type I portland cement in compliance with ASTM C150

2.9 ACCESSORIES

- 2.9.1 Sto-Mesh Corner Bead Standard – one component PVC (polyvinyl chloride) accessory with integral reinforcing mesh for outside corner reinforcement
- 2.9.2 Sto Drip Edge Profile - one component PVC (polyvinyl chloride) accessory with integral reinforcing mesh that creates a drip edge and plaster return
- 2.9.3 StoSeal® STPE Sealant - high-movement, low modulus, non-sag one-component silyl-terminated polyether joint sealant in compliance with ASTM C920 and tested in accordance with ASTM C1382

2.10 MIXING

- 2.10.1 Refer to manufacturer's applicable product bulletins for mixing of materials

3 EXECUTION

3.1 EXAMINATION

- 3.1.1 Inspect concrete and masonry substrates prior to start of application for:
- 3.1.2 Contamination—algae, chalkiness, dirt, dust, efflorescence, form oil, fungus, grease, laitance, mildew, or other foreign substances
- 3.1.3 Surface absorption
- 3.1.4 Cracks—measure crack width and record location of cracks
- 3.1.5 Damage and deterioration such as voids, honeycombs and spalls
- 3.1.6 Moisture content and moisture damage—use a moisture meter to determine if the surface is dry enough to receive the products and record any areas of moisture damage
- 3.1.7 Compliance with specification tolerances—record areas that are out of tolerance (greater than ¼ inch in 10 feet [6mm in 3 m] deviation in plane)
- 3.1.8 Inspect sheathing application for compliance with applicable requirement and installation in conformance with specification and manufacturer requirements:
- 3.1.9 Glass Mat Faced gypsum sheathing compliant with ASTM C1177 – consult manufacturer
- 3.1.10 Exterior Grade and Exposure I wood based sheathing – APA Engineered Wood Association E 30
- 3.1.11 Cementitious sheathing – consult manufacturer
- 3.1.12 Attachment into structural supports with adjoining sheets abutted (gapped if wood-based sheathing) and fasteners at required spacing to resist design wind pressures as determined by design professional
- 3.1.13 Fasteners seated flush with sheathing surface and not over-driven
- 3.1.14 Report deviations from the requirements of project specifications or other conditions that might adversely affect the air and water-resistive barrier or the EIFS installation to the General Contractor. Do not start work until deviations are corrected.

3.2 SURFACE PREPARATION

- 3.2.1 Remove surface contaminants on concrete, concrete masonry, gypsum sheathing, or coated gypsum sheathing surfaces
- 3.2.2 Repair cracks, spalls or damage in concrete and concrete masonry surfaces, and level concrete and masonry surfaces to comply with required tolerances
- 3.2.3 Apply conditioner (consult Sto) by spray or roller to chalking or excessively absorptive surfaces or pressure wash to remove surface chalkiness
- 3.2.4 Remove fasteners that are not anchored into supporting construction and seal holes with air and water-resistive barrier detail material
- 3.2.5 Seal over-driven fasteners with Sto air and water-resistive barrier detail material and install additional fasteners as needed to comply with fastener spacing requirement
- 3.2.6 Fill large gaps between sheathing or voids around pipe, conduit, scupper, and similar penetrations with spray foam and shave flush with surface (refer to Sto Details)
- 3.2.7 Replace weather-damaged sheathing and repair or replace damaged or cracked sheathing

3.3 INSTALLATION

- 3.3.1 Install manufacturer's air and water-resistive barrier in conformance with manufacturer's written instructions ([refer to applicable Sto product bulletins and StoTherm ci Design Guide and Detail Booklets](#))
- 3.3.2 Install manufacturer's EIFS cladding in conformance with manufacturer's written instructions ([refer to product bulletins, StoTherm EIFS: Installation Guide, and StoTherm ci Design Guide and Detail Booklets](#))

3.4 PROTECTION

- 3.4.1 Provide protection of installed materials from water infiltration into or behind them
- 3.4.2 Provide protection of installed materials from dust, dirt, precipitation, freezing and continuous high humidity until they are fully dry

3.5 CLEANING, REPAIR AND MAINTENANCE

- 3.5.1 Clean and maintain the EIFS for a fresh appearance and to prevent water entry into and behind the system. Repair cracks, impact damage, spalls or delamination promptly.
- 3.5.2 Maintain adjacent components of construction such as sealants, windows, doors, and flashing, to prevent water entry into or behind the EIFS and anywhere into the wall assembly
- 3.5.3 Refer to Sto reStore Repair and Maintenance Guide (reStore Program) for detailed information on restoration – cleaning, repairs, recoating, resurfacing and refinishing, or re-cladding

END OF SECTION 07 2400

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

SECTION 07 2500 – WEATHER BARRIERS

1. GENERAL

1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.

1.2 SCOPE – Furnish all labor, materials and equipment to complete all Infiltration and Vapor Barriers Work, as indicated on the drawings and as herein specified. The Contractor will be responsible for providing all work reasonably required under this SECTION Specification Heading.

The work involved under this SECTION shall include but not necessarily be limited to, the following:

- A. Vapor barriers under interior concrete floor slabs on-grade.
- B. Vapor barriers at walls and ceilings.
- C. Infiltration barrier system at exterior walls.

1.3 SUBMITTALS – Submit shop drawings on all infiltration barriers and vapor barriers, showing all details of construction and co-ordination with other items of work, in accordance with SECTION 01 3300 – SUBMITTAL REQUIREMENTS.

1.4 QUALITY ASSURANCE

A. Qualifications

- 1. Installer shall have experience with installation of commercial weather barrier assemblies under similar conditions.
- 2. Installation shall be in accordance with weather barrier manufacturer's installation guidelines and recommendations.
- 3. Source Limitations: Provide commercial weather barrier and accessory materials produced by a single manufacturer for each system.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver weather barrier materials and components in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Store weather barrier materials as recommended by weather barrier manufacturer.

2. PRODUCTS

2.1 VAPOR BARRIERS UNDER INTERIOR CONCRETE FLOOR SLABS ON-GRADE

A. Vapor barrier shall have all the following qualities:

- 1. Maintain permeance of less than 0.01 Perms [grains/(ft² · hr · inHg)] as tested in accordance with mandatory conditioning tests per ASTM E1745 Section 7.1 (7.1.1-7.1.5).

2. Other performance criteria:
 - a. Strength: ASTM E1745 Class A.
 - b. Thickness: 15 mils minimum
 3. Provide third party documentation that all testing was performed on a single production roll per ASTM E1745 Section 8.1
 4. Warranty: (a) compliance with the designated ASTM E1745 classification, and (b) no manufacturing defects in the product for, at least, the Life of the Building.
 - B. Vapor barrier products:
 1. Basis of Design: Stego Wrap Vapor Barrier (15-mil) by Stego Industries LLC., (877) 464-7834 www.stegoindustries.com
 2. Approved Alternate: Vaporguard by Reef Industries, 713-507-4250. www.reefindustries.com
 3. Approved Alternate: Moistop Ultra 15 by Fortifiber, (800) 773-4777. <https://www.fortifiber.com/product/moistop-ultra-15/>
 4. No Substitutions.
 - C. Accessories: Provide seams, sealers, etc. as required from a single source manufacturer for a complete vapor barrier system.
- 2.2 VAPOR BARRIERS AT WALLS AND CEILINGS – Shall be 4 mil polyethylene film vapor barrier with a 0.1 maximum perm rating.
- 2.3 INFILTRATION BARRIER SYSTEM – Shall be Tyvek Commercial Wrap by DuPont.
- A. Performance Characteristics
 1. Air Penetration: 0.001 cfm/ft² at 75 Pa, when tested in accordance with ASTM E2178. Type I per ASTM E1677. ≤0.04 cfm/ft² at 75 Pa, when tested in accordance with ASTM E2357
 2. Water Vapor Transmission: 28 perms, when tested in accordance with ASTM E96, Method B.
 3. Water Penetration Resistance: 280 cm when tested in accordance with AATCC Test Method 127.
 4. Basis Weight: 2.7 oz/yd², when tested in accordance with TAPPI Test Method T-410.
 5. Air Resistance: Air infiltration at >1500 seconds, when tested in accordance with TAPPI Test Method T-460.
 6. Tensile Strength: 38/35 lbs/in., when tested in accordance with ASTM D882, Method A.
 7. Tear Resistance: 12/10 lbs., when tested in accordance with ASTM D1117.
 8. Surface Burning Characteristics: Class A, when tested in accordance with ASTM E 84. Flame Spread: 10, Smoke Developed: 10.
 - B. Accessories – Shall be as required for a complete system by the infiltration barrier manufacturer.

3. EXECUTION

3.1 VAPOR BARRIERS

- A. UNDER FLOOR SLABS VAPOR BARRIERS – Shall be installed over a level compacted granular fill base as before specified and laid single-ply. Apply vapor barrier over the base area surface with the roll width parallel to the direction of the concrete pour. Lap all

sides and head joints 6" minimum. No adhesive at laps is required. Membrane shall be turned up at all vertical surfaces. Install according to manufacturer's directions.

- B. WALL AND CEILING VAPOR BARRIERS – Apply vapor barrier to inside face of exterior wall furring and framing. Fasten securely. Lap edges two (2") inches over framing. Install without tears or perforations.

3.2 INFILTRATION BARRIERS

- A. INFILTRATION BARRIER SYSTEM – Shall be installed as designated on the drawings. Install strictly in accordance with the manufacturer's instructions without tears or perforations. Seal all joints and penetrations through infiltration barrier system.

3.3 PROTECTION – Protect weather barriers from damage.

END OF SECTION 07 2500

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

SECTION 07 5324 – ADHERED ELASTOMERIC MEMBRANE ROOFING

1. GENERAL

- 1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.
- 1.2 SCOPE - Furnish all labor, materials and equipment required to complete all Elastomeric Membrane Roofing, Roof Insulation, Membrane Flashings, etc. as indicated on the drawings, and as herein specified. The Contractor will be responsible for providing all work reasonably required under this SECTION Specification Heading.

Work under this SECTION shall include, but not necessarily be limited to, the following items:

- A. Temporary roof protections and covering while deck is open and exposed to elements.
- B. Wood blocking, plates, cants, etc. at roof edge, soffit, curbs and other miscellaneous roof framing including anchors, rough hardware, leveling grout, etc.
- C. Roof insulation, separate layers as shown on the drawings, and roofing sheathing, mechanically fastened.
- D. Final cleaning of deck.
- E. Carlisle EPDM flexible roof membrane and flashings for a complete Design "A" adhered system.
- F. Membrane flashing at all roof curbs, roof edges, and other locations as detailed or required.
- G. All necessary accessories, mastics, equipment, etc. for a complete system as required in accordance with Carlisle specifications.
- H. Submittals.
- I. Five (5) year watertight guarantee by General Contractor, Roofing Subcontractor and Sheet Metal Subcontractor.
- J. Twenty (20) year watertight guarantee by roofing system manufacturer.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Wood blocking, Furring, Curbs, Sheathing – SECTION 06 1000 – ROUGH CARPENTRY.
- B. Sheet Metal Coving – SECTION 07 6200 – SHEET METAL FLASHING, TRIM, AND ROOFING SPECIALTIES.

1.4 SPECIFICATION BASIS AND ALTERNATE SYSTEM CONSIDERATIONS

- A. The Elastic Sheet Roofing System forming the basis of these Specifications will be the Sure-Seal Design "A" Directly Adhered EPDM membrane as manufactured by the CARLISLE Tire and Rubber Co. in strict accordance with their approved Drawings and Specifications.
- B. Certain Alternate Roofing and Insulation Systems may bid in lieu of the Specified System with prior approval by the Architect of the Alternate System proposed. Approved

Alternate Systems using products equal to that specified are:

1. VERSICO CO.
2. ELEVATE
3. GENFLEX EPDM (GENCORP)
4. MULE-HIDE PRODUCTS

In order to bid any other system, the Contractor must submit specific information on the proposed system prior to bidding for analysis. Approved roofing systems will be formalized and confirmed by ADDENDUM.

1.5 QUALITY ASSURANCE

- A. Apply roofing system using a Roofing Contractor approved by Roofing System Manufacturer and fully in accordance with Roofing System Manufacturer's current specifications and standards.
- B. Basic roof system shall be classified by Underwriters Laboratories, Inc., as "CLASS A" and accepted by the ICBO as meeting the requirements of the International Building Code, although system may not be strictly used in same method on this project as tested.
- C. INSPECTION – Upon completion of the installation, an inspection shall be made by a representative of Roofing System Manufacturer to ascertain that the roofing system has been installed according to Roofing System Manufacturer's published specifications and details.
 1. There shall be no deviation made from this specification without prior written approval by the manufacturer.

1.6 WARRANTY

- A. The General Contractor and Roofing Subcontractor shall unconditionally warranty their work for a period of five (5) years from date of completion of the roof and shall sign and be a party to a written guarantee on a form similar to the "Form of Roofing Guarantee," included as the last page of this SECTION.
- B. The Roofing System Manufacturer's Representative will inspect the installation and upon approval issue a twenty (20) year written warranty for materials and labor.

1.7 SUBMITTALS – Submit Product Data and Shop Drawings from the Roofing Manufacturer for roofing materials, insulation, flashings, etc., to the Architect for approval in accordance with SECTION 01 3300 – SUBMITTAL REQUIREMENTS as follows:

- A. Submit Shop Drawings for approval. Shop Drawings are required for final inspection of the warranted roof. Shop Drawings shall be made by Roofing System Manufacturer or their designated Representative. Shop Drawings shall be approved and assigned a number by Roofing System Manufacturer's Construction Materials Department.
 1. Shop Drawings shall include: Outline of roof and roof size, location and type of penetrations, perimeter and penetration details, special details, and Bill of Material.
- B. Approved applicators may supply Roofing System Manufacturer with an as-built shop drawing for final inspection. As-built shop drawings must be approved and given a shop

drawing number of Roofing System Manufacturer's Construction Materials Department.

- 1.8 SITE AND BUILDING CONDITIONS – The plans do not entirely show the existing conditions and site in total details. The Contractor must visit the existing buildings and site of the construction and ascertain for himself the exact conditions there existing and the extent of the work required. It is to be understood that his failure to do so will be no excuse for claims resulting from his lack of knowledge of the existing conditions, and he is to base his bids on the conditions of the sites and existing buildings "AS IS". He is to provide a fully completed project in accordance with the plans.

2. PRODUCTS

- 2.1 GENERAL – Components to be products of Roofing System Manufacturer or certified by Roofing System Manufacturer as compatible.

2.2 MEMBRANE AND RELATED MATERIALS

- A. Membrane – .060" thick, 50' wide and of length determined by job condition, EPDM compounded elastomer conforming to the Roofing System Manufacturer's published specifications.
- B. Flashing – Uncured neoprene rubber sheet .060" thick, furnished by membrane manufacturer.
- C. Roofing Membrane Bonding Adhesive – Compatible with materials to which the membrane is to be bonded, furnished by membrane manufacturer.
- D. Splicing Cement – Furnished by membrane manufacturer.
- E. Lap Sealant – Compatible with materials with which it is used, shall be trowel or gun consistency, furnished by membrane manufacturer.
- F. Water Cut-Off Mastic – Compatible with materials with which it is used, furnished by membrane manufacturer.
- G. Molded Pipe Flashing – Compatible with materials with which it is used, furnished by membrane manufacturer.
- H. Nite Seal – Compatible with materials with which it is used, furnished by membrane manufacturer.
- I. Pourable Sealer – Compatible with materials with which it is used, furnished by membrane manufacturer.
- J. Rubber Fastening Strips (RFS) and Fasteners – Extruded nailing strips or approved equal and buttress style threaded fasteners furnished by membrane manufacturer.
- K. Protective Mat – Molded walkway pads, .162 - .202 thickness, furnished by membrane manufacturer.

2.3 INSULATION

- A. EXPANDED POLYSTYRENE – Shall be ACH Foam-Control Plus 150, InsulFoam InsulRoof II, or *approved equal*; *1.5 lb./Cu.Ft. density minimum*, expanded polystyrene foam of thickness as shown on the drawings (modified grade) meeting Federal Spec. HH-1524C, ASTM C578, Type II, Class A, carrying UL Laboratory Classification for Class A Roof Systems. *Long-term Thermal Resistance (LTTR) value shall equal 4.2/inch thickness at mean temp of 40 degrees F* when tested in accordance with ASTM C1303. Only specific brands of insulation approved by the Architect prior to bidding will be used. Other manufacturers wanting approval of their insulation shall submit UL certification data and independent laboratory testing directly to the Architect's Office for written approval by Addendum.
- 2.4 ROOFING SHEATHING – Shall be ¼" thick rigid board insulation equal to Securock by USG or Dens Deck by Georgia Pacific. Install where shown on the Drawings. Cut, taper edge and other accessories shall be where detailed and required.
- 2.5 DELIVERY AND STORAGE – Materials shall be delivered in their original, unopened containers, clearly labeled with manufacturer's name, brand name, and such identifying numbers as are appropriate. Adhesives shall be stored between 60 degrees F and 80 degrees F. Should they be exposed to lower temperatures, restore to room temperature for three to five days prior to use. Do not use materials damaged in handling or storage.

3. EXECUTION

- 3.1 GENERAL – The work under this Section should be in keeping with first-class workmanship in the best practice of the trade and shall be accomplished by a qualified Contractor who shall be capable of planning and coordinating the entire work.

When ready for roofing, the entire deck or insulation shall receive a last cleaning by blowing or vacuuming the deck of all debris, dust, etc. just prior to the roofing operations. Deck shall be dried as required for proper installation of the membrane.

3.2 WOOD BLOCKING AT ROOF

- A. Install all wood blocking, plates, cants, etc. plumb, level, true, and square to dimensions shown. All work, including fasteners, shall be in keeping with the best standard practice of the industry and shall be done by competent mechanics skilled in their trade.
- B. Anchor in a substantial manner as detailed or as approved by the Owner's Representative to resist force of 75#/LF in any direction. Block and shim where necessary. Use metal anchors as detailed or required for proper fastening. Fasteners and anchors shall not be countersunk to exceed ½" or ½ the thickness of the wood, whichever is less. Nail blocking together with a minimum of 16d coated nails @ 16" o.c.
- C. Fill under blocking where required with grout before installing wood blocking.

- 3.3 MECHANICALLY FASTEN insulation and roofing sheathing according to manufacturer's recommendations with buttress type threaded screws.

3.4 MEMBRANE INSTALLATION

A. GENERAL

1. Position membrane (recommended maximum width 10 feet) over approved substrate without stretching.
2. Allow membrane to relax approximately ½ hour prior to bonding.
3. Fold sheet back five feet so that half of the underside of the sheet is exposed. Sheet fold shall be smooth without wrinkles or buckles.
4. Apply bonding adhesive evenly, without globs or puddles, with a 9 inch plastic core paint roller. DO NOT APPLY BONDING ADHESIVE TO THE SPLICE AREA. Adhesive shall be firmly applied to both the sheet and the substrate. One (1) gallon of bonding adhesive, applied correctly, will cover 60 Sq.Ft. of finished surface at moderate temperature. Allow adhesive to dry until it is tacky, but will not string or stick to a dry finger touch.
5. Roll the coated membrane into the coated substrate while avoiding wrinkles.
6. Brush down bonded half of the sheet with a push broom to achieve maximum contact.
7. Fold back the unbonded half of the sheet and repeat the bonding procedure.
8. Install adjoining sheets in the same manner, lapping edges a minimum of 3". NOTE: At all inside angle changes where slope exceeds 2" in one horizontal foot, Rubber Fastening Strip is required to be installed.

B. MEMBRANE SPLICING

1. Fold top sheet back about 12". Remove dirt and excess dust by brooming or wiping with a clean rag, if necessary, by scrubbing with warm soapy water and rinsing with clean water. Clean both of the dry mating surfaces of the splice area using clean natural fiber rags or natural sponges with Sure-Seal Cleaner. The finished surface should be solid black in color.
2. After thoroughly stirring, apply splicing cement to both surfaces using a 3" or 4" wide, ½" thick paint brush. Apply cement in the manner and at the rate specified on the container label. Brush cement on smoothly to obtain 100% coverage. Do not allow the cement to glob or puddle. Allow cement to dry until it is tacky but will not string or stick to a dry finger touch.
3. Roll top sheet toward splice area until the cemented surface is nearly touching the cement on the bottom sheet along the entire length of splice. Allow sheet to fall freely into place. Avoid stretching and wrinkling while brushing with a hand toward the splice edge.
4. Roll splice with a 2" wide steel roller, using positive pressure, toward the outer edge of the splice.
5. Clean the splice edge, extending at least 1" onto the top and bottom membranes with Sure-Seal splice cleaner.
6. Apply a bead of Lap Sealant completely covering the splice edge. Feather the Lap Sealant with a specially preformed putty knife or trowel. Complete Lap Sealant application of all splices by the end of each working day.

C. PERIMETER MEMBRANE SECUREMENT

1. Securement shall be provided at the perimeter of each roof level, roof section, curb flashing, skylight, expansion joint, interior wall, penthouse, etc. and at any inside angle change where slope exceeds 2" in one horizontal foot.
2. Rubber Fastening Strip (RFS) shall be mechanically fastened through the membrane insulation and into the structural substrate, as shown on Carlisle's standard details, with Carlisle Sure-Seal Universal Fasteners.

- a. The top of mechanical fasteners shall be set flush with the top surface of the RFS. Space mechanical fasteners a maximum of 12" o.c. starting 1" from the end of the RFS.
 - b. If breaks for drainage are necessary, separate the adjoining strips with 6" space.
 - c. After mechanically fastening the RFS it shall be flashed with Sure-Seal flashing.
- D. FLASHING – Perimeter flashing and flashing around vents, equipment, pipes, etc. shall be done with Sure-Seal Elastoform Flashing using the longest pieces practicable. All flashings and terminations shall be done in accordance with Carlisle's standard details.
 1. Complete splice between flashing and main roof sheet before bonding flashing to vertical surface. Splice shall extend at least 3" beyond the fasteners which attach the membrane to the horizontal surface.
 - a. Apply bonding adhesive to both flashing and surface to which it is being bonded at a rate covering approximately 60 Sq.Ft. of finished surface.
 - b. After the bonding adhesive has dried to the point where it does not string or stick to a dry finger, roll the flashing into the adhesive. Care must be taken to assure that the flashing does bridge where there is any change or direction (e.g. - where the parapet meets the roof deck).
 - c. Nail installed flashing at top of flashing every 12" o.c. maximum under metal counterflashing or cap or other means as detailed or approved by Architect and Carlisle.
 2. Flash all penetrants (pipes, conduits, etc.) passing through the membrane.
 - a. Flash pipe with molded pipe flashings where installation is possible.
 - b. Where molded pipe flashings cannot be installed, use field fabricated pipe seals.
 - c. In re-roofing, remove existing lead pipe flashing.
 3. Seal clusters of pipes and unusual shaped penetrations with two (2") inch minimum Sure-Seal Pourable Sealer. Use sealant pocket type seal as shown in Carlisle's standard details.
 4. Roof Drains:
 - a. In re-roofing, remove existing lead flashing and cement in preparation for Water Cut-Off Mastic and membrane seal.
 - b. Taper insulation around drain to provide a smooth transition from roof surface to drain clamping ring.
 - c. Seal between membrane and rain base shall be Water-Cut-Off Mastic as shown in Roofing System Manufacturer's standard details.
 - d. When all work at drains is completed, the Contractor shall check each drain to be sure they are free, clear and full flowing.
- E. DAILY SEAL – Care should be exercised to ensure that the water does not flow beneath any completed sections of roof. Temporarily seal loose edge of membrane with Nite Seal when weather is threatening.
 1. Mix the two components thoroughly according to the instructions on the label.
 2. Apply the Nite Seal at a rate of 100 LF/gallon, (on smooth surface) (12") inches back from edge of sheet onto exposed substrate surface. If necessary, use a trowel to spread material in order to achieve complete seal. Onto existing built-up roof surface, this coverage will be reduced according to surface preparation.
 3. After embedding membrane in Nite Seal, check for continuous contact. Then weight the edge, providing continuous pressure over the length of the cut-off. The

recommended weight for the continuous pressure is a ten (10') foot length of 2 ½" Sure-Seal Lay Flat Tubing filled with dry sand.

4. When work is resumed, pull sheet free before continuing installation.

F. TIE-IN – Shall be done strictly in accordance with manufacturer's best recommendations including metal bar anchor strip, special seals, fasteners, grubbing back, etc. Similar tie-in work shall be done at patches and new roof curbs to tie to existing built-up roof to remain.

3.5 PROTECTION – Protect all materials, insulation roofing, etc., from water and moisture by storing materials either off the site in a dry warehouse or at the site in watertight trailers, sheds, or other type enclosures; as covering with polyethelene film, tarpaulins, etc. will not be acceptable. Protect the building and property from damage and water leakage at all times. Deliver materials in manufacturer's original, unopened containers and rolls with label intact and legible. Handle rolled goods so as to prevent damage to edge or ends. Store rolled goods on end. Select and operate material handling equipment so not to damage existing construction or applied roofing.

END OF SECTION 07 5324

FORM OF ROOF GUARANTEE

Date: _____

TO: Board of Directors
Colfax Economic Development Corporation
20 W Broadway
Colfax, IA 5054

RE: Roof Guarantee, Project No. 2025-055
Colfax-Mingo Childcare Center
Roof
Colfax, IA

We, the Undersigned Contractors and Subcontractors, hereby, individually guarantee for a period of five (5) years from the above date, to replace any defective material and to repair any leaks, blisters, ridges, or other faults that may develop in the roofs, flashings, sheet metal or other work of this contract which may be due to defects in materials required to fulfill this guarantee will be borne by the undersigned.

In case the repairs are not made or defective work is not replaced within seven (7) days from date of notice that defects exist, the Owner may have such repairs made or materials replaced as required and the undersigned agree to pay all such costs within thirty (30) days from the date repairs are made and materials replaced.

General Contractor _____

By _____

Address _____

Roofing Contractor _____

By _____

Address _____

Sheet Metal Subcontractor _____

By _____

Address _____

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

SECTION 07 7200 – ROOF ACCESSORIES

1. GENERAL

1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.

1.2 SCOPE – Provide all labor, materials and equipment required to fully complete all Roof Accessory Work, as shown on the drawings and as herein specified. The Contractor will be responsible for all work reasonably required under this SECTION Specification Heading.

Work involved under this SECTION shall include, but not necessarily be limited to, the following items:

- A. Roof vents.
- B. Shop Drawings.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Flashing and Sheet Metal – SECTION 07 6200 – SHEET METAL FLASHING, TRIM, AND ROOFING SPECIALTIES.
- B. Roofing – SECTION 07 5324 – ADHERED ELASTOMERIC MEMBRANE ROOFING
- C. Joint Sealant – SECTION 07 9000 – JOINT SEALANTS.

1.4 SUBMITTAL – Submit Shop Drawings showing all sizes, materials, details of construction, profile and gauge of all components, fasteners, trim, sealants, and other details as necessary to identify and erect a weather-tight wall. Submit drawings in accordance with SECTION 01 3300 – SUBMITTAL REQUIREMENTS.

1.5 QUALITY ASSURANCE

- A. MANUFACTURER QUALIFICATIONS – Minimum of five (5) years experience in manufacturing roof panels similar to those specified.
- B. INSTALLER QUALIFICATIONS – Acceptable to roofing manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING – Deliver materials to the project site in manufacturer's original crating, properly labeled for identification purposes. Wrap all metal with a strippable plastic film. Store materials in accordance with panel manufacturer's recommendations. Handle materials carefully to avoid damage to panels and finishes.

1.7 WARRANTY – Snow guards shall have a lifetime parts and labor warranty.

2. PRODUCTS

- 2.1 ROOF VENT – Shall be FAMCO GBV24 Globe Vent or approved equal. Gravity ventilator, 24 guage galvanized steel. Sized to provide 450 sq. in. minimum free ventilated area.

END OF SECTION 07 7200

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

SECTION 07 7233 – ROOF HATCHES

1. GENERAL

- 1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.

- 1.2 SCOPE – Provide all labor, materials and equipment required to fully complete all Roof Hatch Work, as shown on the drawings and as herein specified. The Contractor will be responsible for all work reasonably required under this SECTION Specification Heading.

Work involved under this SECTION shall include, but not necessarily be limited to, the following items:

- A. Roof Hatch.
- B. Submittals.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Roof Insulation & Thermoplastic Membrane Roofing – SECTION 07 5423 – THERMOPLASTIC MEMBRANE ROOFING.

- 1.4 SUBMITTALS – Submit Shop Drawings showing all sizes, materials, details of construction, profile and gauge of all components, fasteners, trim, sealants, and other details as necessary to identify and erect a weather-tight assembly. Submit drawings in accordance with SECTION 01 3300 – SUBMITTAL REQUIREMENTS.

1.5 QUALITY ASSURANCE

- A. MANUFACTURER QUALIFICATIONS – Minimum of five (5) years experience in manufacturing and installation of components specified herein.
- B. SINGLE SOURCE RESPONSIBILITY – Obtain roof hatch units and frames for the project from one (1) source and one (1) single manufacturer.

- 1.6 DELIVERY, STORAGE, AND HANDLING – Deliver materials to the project site in manufacturer's original crating, properly labeled for identification purposes. Store materials in accordance with panel manufacturer's recommendations. Handle materials carefully to avoid damage to finishes.

- 1.7 WARRANTY – Roof hatch materials and installation shall be guaranteed for a period of five (5) years from date of acceptance.

2. PRODUCTS

2.1 APPROVED ROOF HATCH MANUFACTURERS

- A. Babcock-Davis, 9300 73rd Ave. N, Brooklyn Park, MN 55428.
- B. Nystrom Building Products, 1701 Madison Street NE, Minneapolis, MN 55413-1400.
- C. JL Industries Inc., 4450 W. 78th Street Circle, Bloomington, MN 55435.

2.2 GALVANIZED STEEL ROOF HATCH

- A. Unit Size – 36" x 30"
- B. Cover and Liner – 14 gauge galvanized steel cover with 1" rigid fiberboard insulation and 22 gauge galvanized steel cover liner.
- C. Curb – 14 gauge galvanized steel with 3/4" rigid fiberboard insulation at curb perimeter.
- D. Hinges – Zinc plated steel tamperproof hinge contained within hatch as part of spring assembly.
- E. Latch – Zinc plated steel slam latch with turn handle and inside/outside padlock hasps.
- F. Springs – Greased heavy-duty compression springs in telescoping tubes.
- G. Hardware – Zinc plated steel hold open arms with rubber handle that automatically locks the door when opened. Furnish hatches with interior padlock hasp and EPDM draft seal.
- H. Mounting Flanges
 - a. Single Wall Curb: 3 ½".
 - b. Double Wall Curb: 2 ½".

2.3 FINISH – Shall be manufacturer's standard factory applied powder coat paint.

3. EXECUTION

3.1 EXAMINATION

- A. Examine the areas and conditions under which materials are to be installed and notify the Architect in writing of conditions detrimental to the proper and timely completion of the work.
- B. Verify that deck, curbs, roof membrane, base flashing, and other items affecting the work of this Section are in place and positioned correctly.
- C. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install roof accessory items and components per manufacturer's instructions.
- B. Coordinate installation of components of this Section with installation of roof deck, roof structure, roofing membrane, base flashing, sealant, and all other miscellaneous items to ensure water tightness.
- C. Separate metal from incompatible metal or corrosive substrates, including wood, by coating concealed surfaces, at locations of contact, with bituminous coating or providing other permanent separation.
- D. Flange Seals – Unless otherwise indicated, set flanges of accessory units in a thick bed of roofing cement to form a seal.

3.3 ADJUSTING AND CLEANING

- A. Adjust movable parts for smooth operation.
- B. Test-operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.
- C. Clean exposed surfaces per manufacturer's written instructions. Touch up damaged metal coatings.

END OF SECTION 07 7233

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

SECTION 07 9000 – JOINT PROTECTION

1. GENERAL

- 1.1 RELATED DOCUMENTS - DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 - GENERAL REQUIREMENTS apply to work of this SECTION.
- 1.2 SCOPE – Furnish all labor, materials and equipment required to complete all Sealant Work shown on the drawings and as herein specified. The Contractor will be responsible for all work reasonably required under this SECTION Specification Heading.

The work involved under this SECTION shall include, but not necessarily be limited to, the following:

- A. Sealant at aluminum and hollow metal door frames and walls, interior and exterior.
 - B. Miscellaneous sealant application as noted on the drawings or as required.
 - C. Sealant at joint backing and fillers.
 - D. Acoustical sealant
 - E. Sealant at exterior wall openings between the frames and adjacent material on the exterior side of the frame including louvers and mechanical openings.
 - F. Sealant at concrete slab to building joint.
 - G. Wherever dissimilar materials meet.
- 1.3 WARRANTY – All sealant work and joint filling in this SECTION shall be guaranteed against separation or water leakage for a period of one (1) year from the date of final payment for the building.
- 1.4 QUALITY ASSURANCE
- A. INSTALLER QUALIFICATIONS – Sealant application contractor with five (5) years minimum experience in sealant application.
- 1.5 SUBMITTALS – Submit product data, color samples, and sealant application contractor qualifications to the Architect for approval in accordance with SECTION 01 3300 – SUBMITTAL REQUIREMENTS.

2. PRODUCTS

- 2.1 EXTERIOR SEALANT – Shall be Tremco Vulkem 116, BASF MasterSeal NP-1, or approved equal; one component, polyurethane sealant used in strict accordance with manufacturer's instructions. Color is to be as selected by the Architect from manufacturer's standard colors. Application is to be gun.
- 2.2 BACKER ROD – Shall be a Soft Backer Rod by BASF MasterSeal, or approved equal; closed cell, non-gassing, polyethelene.
- 2.3 GLASS SEALANT – For butt joint glazing of Insulating Glass and 1/4" Heat Strengthened Vision Glass where specified and as detailed shall be DOW CORNING, No. 795, Black

Colored Neutral Cure-Type Silicone Sealant.

- 2.4 EXTERIOR CONTROL JOINTS AND CONCRETE SLABS ABUTTING THE BUILDING – Shall be sealed over a compatible expansion strip and filler depressed a dimension equal to ½ the width of the joints, or 3/8" minimum. Sealant shall be a one-component urethane, twenty (20) year life, self-priming equal to Vulkem 116 by Tremco, MasterSeal NP-1 by BASF, or approved equal.
- 2.5 INTERIOR SEALANT – Shall be Tremflex 834 by Tremco, or approved equal; one-part, siliconized acrylic, gun-grade.
- 2.6 ACOUSTICAL SEALANT – Shall be Tremco Acoustical Sealant, non-hardening, resilient acoustical sealant.

3. EXECUTION

- 3.1 GENERAL – All sealing application shall be done by skilled mechanics, experienced in this work and shall be done in a neat, clean manner with joints finished true and smooth. All work shall be done strictly in accordance with the manufacturer's recommendations and instructions.
- 3.2 SEALANT AT DOOR AND WINDOW FRAMES – Shall be as before specified and backed with joint backing unless otherwise noted. Sealant at exterior of outside joints only. Sealant application shall finish behind the face of the frame as detailed. All sealant depths shall be the same depth as the joint width. The joint filler material shall be set to accommodate this joint plus the joint reveal.
- 3.3 ACOUSTICAL SEALANT
- A. Will be required at ALL Walls and Ceilings with Sound Control Insulation in the following locations:
1. The perimeter of all walls on both sides of the wall.
 2. Behind control joints.
 3. All wall penetrations, intersections, and junctures including: switch and outlet boxes for electrical, telephones, computer, TV, and penetrations for cabinets, plumbing, heating, and air conditioning pipes/ducts.
- B. ACOUSTICAL SEALANT INSTALLATION
1. At Partition Wall Perimeter – Cut gypsum boards for loose fit around partition wall perimeter. Leave a groove no more than 1/8" wide. Apply a ¼" min. round bead of sealant to each side of runners, including those used at partition intersections with dissimilar wall construction. Immediately install boards, squeezing sealant into firm contact with adjacent surfaces. Fasten boards in normal manner. Gypsum panels may have joint treatment applied in normal manner over sealed joints, and gypsum base finished with base as specified.
 2. Openings – Apply sealant around all cut-outs such as at electrical boxes, plumbing, medicine cabinets, heating ducts and cold-air returns to seal the opening. Caulk sides and backs of electrical boxes to seal them.

END OF SECTION 07 9000

DIVISION 08 – OPENINGS

SECTION 08 1113 – HOLLOW METAL DOORS AND FRAMES

1. GENERAL

- 1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.
- 1.2 SCOPE – Furnish all labor, materials and equipment required to furnish and install all Hollow Metal Door and Frame Work shown on the drawings and as herein specified. The Contractor will be responsible for all work reasonably required under this SECTION Specification Heading.
- The work involved under this SECTION shall include, but not necessarily be limited to, the following:
- A. Hollow metal doors.
 - B. Hollow metal door frames.
 - C. Hardware, reinforcements, brackets, balls, anchors, screws, spacing brackets, rubber door silencers, and all other work and material reasonably required under this SECTION.
 - D. Prime Painting.
 - E. Submittals.
- 1.3 RELATED WORK SPECIFIED ELSEWHERE
- A. Finish Hardware – SECTION 08 7100 – DOOR HARDWARE.
 - B. Painting – SECTION 09 9000 – PAINTING AND COATING
- 1.4 WARRANTY – Upon completion, all items shall be left in perfect condition, with all doors swinging free and closing noiselessly. The manufacturer shall issue a written warranty against defects in materials and workmanship for a period of one (1) year from date of final project.
- 1.5 SUBMITTALS – Submit detailed shop drawings showing sizes, materials, frame sections, etc., for approval in accordance with SECTION 01 3300 – SUBMITTAL REQUIREMENTS.
- 1.6 FIRE-RATED ASSEMBLIES – Labeled products shall bear UL, FM, Warnock-Hersey or other approved inspection agency labels. Construct assemblies to comply with NFPA 80.

2. PRODUCTS

- 2.1 APPROVED MANUFACTURERS – Shall be Curries Manufacturing, Inc. of Mason City, IA, or other approved equal. Prior to bidding, equal manufacturers must be approved by Architect, and shall comply with the requirements of this specification, including fire-ratings, and as indicated on the drawings.
- 2.2 STANDARD DOORS AND FRAMES

A. METALS

1. Standard Frames – Paint-Lock galvanealed furniture grade steel.
2. Doors – Full cold-rolled, stretcher leveled furniture steel.
3. Galvanized Doors and Frames – Hot-dipped zinc coated steel complying with ASTM designations A924 and A653.

B. FRAMES

1. Interior Stud Wall Door Frames – Shall be of 16 gauge material, equal to Curries Standard Drywall Frames; knock-down; bonderized with factory prime coat. (NOTE: Special back-bend configuration and scheduled frames to be welded.)
2. Exterior Stud Wall Door Frames – Shall be of 16 gauge material, equal to Curries Mercury Thermal Break Frames; knock-down; bonderized with factory prime coat. (NOTE: Special back-bend configuration and scheduled frames to be welded.)

C. HOLLOW METAL DOORS

1. Interior Doors – Shall be equal to Curries #747 Series Doors, or approved equal. Doors will be flush construction, reinforced with 18 gauge vertical stiffeners on 6" centers, 18 gauge face sheets. All doors will be reinforced with 12 gauge closer reinforcement channel. Lock rails are to be a 14 gauge channel. Hinge rail to be one 12 gauge channel. Top and bottom shall have 16 gauge channels. Provide glass opening where scheduled. Install other accessories as noted. Furnish labels as noted.
2. Exterior Doors – Shall be equal to Curries #777 Trio-E Series Doors, or approved equal. Doors will be flush construction, reinforced with 22 gauge vertical stiffeners, 18 gauge face sheets. All doors will be reinforced with 14 gauge closer channel. Lock rails are to be a 14 gauge channel. Hinge rail to be one 12 gauge channel. Top and bottom shall have 16 gauge channels. Provide glass opening where scheduled. Install other accessories as noted. Doors shall be insulated with polyurethane insulation between stiffeners.

D. HARDWARE REINFORCEMENTS – All frames shall have hardware requirements as follows:

1. Butts - #7 gauge x 1 5/8" x 10".
2. Strikes - #14 gauge x 1 5/8" x 4".
3. Checks - 12 gauge x 16" channel.
4. Floor Clips - #12 gauge.
5. Locks - #14 gauge.

E. ANCHORAGE – All anchors and other fasteners necessary for proper fastening in place will be furnished by the Hollow Metal Manufacturer.

3. EXECUTION

3.1 HOLLOW METAL DOOR FRAMES

- A. Shall be gauge and material above specified, and of Section detailed.
- B. Hinge, strike plate, and switch cut-outs shall be protected with pressed steel cover boxes spot welded to back of frames behind mortises.
- C. All frames shall be furnished with rubber door silencers.

3.2 HOLLOW METAL WINDOW, TRANSOM, AND SIDELIGHT FRAMES

- A. Furnish frames of hollow metal sections for glazing as detailed. Provide solid steel stops at exterior glass openings. Anchorage shall be the same as for Door Frames.
- B. Hollow Metal sections shall be fabricated of the gauge previously specified for metal and shall be thoroughly cleaned and given shop coat of top grade metal primer.
- C. Frames shall be shop assembled with all joint and connections mitered and continuous welded on back side where possible and elsewhere face welded and welds smooth ground except for outside corners of frames where flush hair-line miter joint may show. Interior view windows may be constructed of K.D. Drywall Frames.
- D. All loose stops shall be solid steel or hollow metal as detailed, shop fitted mitered at corners drilled and countersunk for oval head metal screw attachment to frames.
- E. All stops will be applied by the Glazing Subcontractor at the time the glazing of frames and sash is done.

3.3 PAINTING

- A. FRAMES – To be completely and thoroughly shop cleaned and given one (1) coat of top grade metal primer.
- B. DOORS – Are to be completely and thoroughly cleaned, sanded and metallic filled where necessary to obtain a perfectly smooth and level finish surface.

Generally, provide two (2) spray coats of top grade rust inhibitive, oxide primer, each coat sanded and baked. Cover all parts, interior and exterior with this paint.

- 3.4 WORKMANSHIP – Hollow Metal work shall be done in accordance with the best practice of the trade and in accordance with the drawings and approved shop drawings. Fully protect doors as required to insure perfect arrival at the job site. Installation shall be first-class, plumb and true, equal to the best practice of the trade.

END OF SECTION 08 1113

DIVISION 08 – OPENINGS

SECTION 08 1400 – WOOD DOORS

1. GENERAL

1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.

1.2 SCOPE – Furnish all labor, materials, and equipment required to completely furnish all Wood Doors as shown on the drawings and as herein specified. The Contractor will be responsible for all work reasonably required under this SECTION Specification Heading.

The work involved under this SECTION shall include, but not necessarily be limited to, the following:

- A. Hardwood interior wood doors, solid core as scheduled and including fire resistant construction.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Installation of Finish Hardware and Wood Doors – SECTION 06 2000 – FINISH CARPENTRY.
- B. Hollow Metal Frames – SECTION 081113 – HOLLOW METAL DOORS & FRAMES.
- C. Furnishing of Finish Hardware – SECTION 08 7100 – DOOR HARDWARE.
- D. Glass and Glazing – SECTION 08 8000 – GLAZING.

1.4 SUBMITTALS – Submit shop drawings showing all sizes, materials, details of construction, etc. in accordance with SECTION 01 3300 – SUBMITTAL REQUIREMENTS.

1.5 SAMPLES – Submit samples of wood for selection by Owner's Representative. Do not proceed with ordering until samples are approved.

1.6 GUARANTEE – Furnish to the Owner, a manufacturer's written guarantee covering all new solid core wood doors herein specified, stating that during the life of the installation, manufacturer will replace without charge any door which becomes unserviceable or unfit for use and pay reasonable re-hanging and refinishing costs.

1.7 COMPLIANCE WITH STANDARD AND INDUSTRY SPECIFICATIONS – Any materials or operation specified by reference to the published specifications of a manufacturer, the Architectural Woodwork Institute (AWI), National Lumber Manufacturer's Association (NLMA), Douglas Fir Plywood Association (DFPA), Hardwood Plywood Institute (HPI), National Woodwork Manufacturer's Association (NWMA), Underwriter's Laboratories, Inc. (UL), or other Publishing Standards, shall comply with the requirements of the standard listed.

- A. In case of conflict between the referenced specifications and the project specifications, the project specifications shall govern.

- B. In case of conflict among the referenced specifications, or standards, the one having the more stringent requirements shall govern.

2. PRODUCTS

- 2.1 WOOD SOLID CORE DOORS – Interior solid core doors shall be 1 ¾" thick, 5-ply flush bonded doors conforming to WDMA I.S. 1-A for premium grade doors.

A. 5-Ply Flush Bonded Doors

1. STC Rating: STC-31
2. Stiles: Structural Composite Lumber (SCL) With Wood Edge: Compatible species as face veneer.
3. Rails: Structural composite lumber (SCL). Factory Sealed.
4. Core: Particleboard in accordance with ANSI A208.1, Grade 1-LD-2.
5. Door Assembly:
 - a. Stiles and Rails: Bonded to core.
 - b. Sand entire assembly flat as a unit to ensure minimal telegraphing of core components through face veneers.
6. Composite Crossbands: Apply to core in hot press using Type I, exterior, water-resistant adhesive, before application of hardwood edges.
7. Veneers:
 - a. Species: maple
 - b. Cut: plain sliced
 - c. Veneer Match: slip
 - d. Minimum thickness before sanding: 1/42"
 - e. Finish: prefinished, standard color as selected by the Architect.
8. Vision Panel Openings: shall be factory cut with a standard lite molding frame, profile as selected by Architect.

3. EXECUTION

- 3.1 WORKMANSHIP – Fabrication work shall be done in accordance with the best practice of the trade and in accordance with the drawings and approved shop drawings. Fully protect doors as required to insure perfect arrival at the job site.

END OF SECTION 08 1400

DIVISION 08 – OPENINGS

SECTION 08 4113 – ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

1. GENERAL

- 1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.
- 1.2 SCOPE – Furnish all labor, materials, and equipment required to complete all Aluminum Entrance and Storefront Work, as shown on the drawings and as herein specified. The Contractor will be responsible for all work reasonably required under this SECTION Specification Heading.

The work involved under this SECTION shall include, but not necessarily be limited to, the following:

- A. Exterior aluminum storefront entrance doors, sidelights, and transoms.
- B. Interior aluminum storefront vestibule doors, sidelights and transoms.
- C. All accompanying door hardware, thresholds, sealants, weather-stripping, and required accessories, etc., except as otherwise noted.
- D. Submittals.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Aluminum flashings, closures and trim – SECTION 07 6200 – SHEET METAL FLASHING, TRIM, AND ROOFING SPECIALTIES.
- B. Sealants – SECTION 07 9000 – JOINT PROTECTION.
- C. Glass and Glazing – SECTION 08 8000 – GLAZING.
- D. Door Hardware - SECTION 08 7100 DOOR HARDWARE.

- 1.4 SUBMITTALS – Submit detailed shop drawings showing sizes, materials, frame sections, hardware, etc., and samples for approval in accordance with SECTION 01 3300 – SUBMITTAL REQUIREMENTS.

- 1.5 WARRANTY – Storefronts shall have a ten (10) year warranty.

2. PRODUCTS

- 2.1 GENERAL – The components for the work under this SECTION shall be equal to the type and quality of the products of Kawneer Company, Inc. of Niles, MI, for doors, frames, trim, anchors, hardware, etc., as shown on the drawings or as specified herein. Other equal manufacturers should submit information to the Architect for approval prior to bidding as specified elsewhere. Other approved manufacturers using products equal to the specified are as follows:

- Manko Window Systems Inc., Manhattan, KS.
- EFCO Corporation, Monett, MO.
- Tubelite Inc., Walker, MI.

- 2.2 MATERIALS – Shall be extruded members having the properties of Architectural Alloy

No. 6063-T5. Screws shall be of color to match finish and shall be of stainless steel or corrosion resistant material of sufficient strength to perform the function for which they are used.

- 2.3 ALUMINUM STOREFRONT FRAMING – For all door sidelight/transom units and framing at window openings under the Contract, as detailed, shall be custom fabricated from manufacturer's standard components as indicated on the details of the drawings. All glazing of the window frames shall be neoprene glazing strips furnished by the manufacturers and installed in accordance with the manufacturer's best recommendations, and as specified in SECTION 08 8000 – GLAZING. Grid framing material shall be "Kawneer "TRI-FAB 450 and 451UT" Systems as shown on the drawings. Framing members, transition members, mullions, adapters and mountings shall be extruded of aluminum with alloy and temper consistent with the method of manufacture. All reinforcements will be concealed and fastened in place without attaching material being visible. Manufacturer will provide frames, stiffeners, and frame extensions, at vertical mullion between doors and transom as required to secure and to stiffen the final assembly to provide the needed strength against wind and other normal loadings. Furnish and install Kawneer sill flashing. Exterior Door Frame Types shall be Kawneer 451T storefronts. Interior Frame Types shall be Kawneer 450 storefronts.
- 2.4 ALUMINUM DOORS – Shall be custom fabricated from manufacturer's standard components as indicated on the drawings and equal to the products and materials of Kawneer.
- A. Aluminum Doors – For all units under this Contract as detailed will be Kawneer Series 350 MEDIUM STILE single acting aluminum doors. Corner construction shall consist of both sigma deep penetration weld and mechanical fastening. Glazing stops shall be snap-in type with neoprene bulb-type glazing. No exposed screws shall be required to secure stops. Stops on exterior side shall be lock-in tamper-proof type. Door leaf shall be equipped with adjustable mechanism located in top rail near lock stile which will provide for minor clearance adjustments after installation. Doors shall be weather-stripped on three (3) sides with metal-backed pile cloth installed in the door and/or frame. The bottom of exterior doors will be weathered with a pile sweep weather-strip #38-166 exterior applied to the door rail.
- B. HARDWARE – All door hardware for aluminum entrance doors shall be installed in the doors by the door manufacturer or entrance contractor. The door manufacturer shall furnish and install in all new aluminum doors the following Kawneer standard items (except as otherwise noted): See Door Hardware, SECTION 08 7100 – DOOR HARDWARE.
- 2.5 FABRICATION – Quality, materials, finish, fastenings, stiffeners, extension, etc., shall be in accordance with the manufacturer's standard specification and as detailed on the drawings. Glazing on both sides of the glass in doors and frames shall receive a neoprene glazing bead or approved equivalent.
- 2.6 ANODIZED FINISH – All storefronts and doors shall have a #40 Dark Bronze anodized finish in accordance with Aluminum Association Specification AA-M10C21A44.
- 2.7 DESIGN – All materials sections, components, fasteners, etc. shall be designed to withstand a horizontal wind force loading in accordance with the International Building

Code and/or other applicable codes. Manufacturer or Fabricator shall furnish internal stiffener bars or other approved bracing members to stiffen vertical sections to provide the required wind resistance.

- 2.8 ENERGY CODE COMPLIANCE – All exterior aluminum Doors shall meet or exceed the IECC 2012 prescriptive U-factor requirement of U-0.77 for entrance doors. All fixed aluminum storefront framing shall meet or exceed the IECC prescriptive U-factor of U-0.36 for fixed fenestration.

3. EXECUTION

- 3.1 WORKMANSHIP – Quality, materials, finish, erection, fastenings, reinforcement and cleaning shall be in accordance with manufacturer's standard specifications by skilled mechanics experienced in this work. All items shall be set in their correct locations as shown in the details and shall be level, square, plumb, and at proper elevations and in alignment with other work. All materials shall be screwed in place using backing, masonry plugs, or anchor straps as required. Where moldings are joined, they shall be accurately butt and fitted to result in a tightly closed joint.
- 3.2 GLAZING – All glazing of doors and sidelights shall be done with neoprene glazing strips furnished by aluminum manufacturers as specified in SECTION 08 8000 – GLAZING.
- 3.3 CLEANING AND PROTECTION – After erection, the Contractor shall adequately protect exposed portions of the grid framing from damage by grinding and polishing machines, plaster, lime acid, cement, or other harmful compounds.

The Contractor shall be responsible for removal of protective materials and cleaning with plain water, or water with soap or household detergent. The Contractor shall be held responsible for damages resulting from the use of other cleaning materials.

END OF SECTION 08 4113

DIVISION 08 – OPENINGS

SECTION 08 5400 – COMPOSITE WINDOWS

1. GENERAL

- 1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.
- 1.2 SCOPE – Furnish all labor, materials, and equipment required to complete all Fiberglass Window Work, as shown on the drawings and as herein specified. The Contractor will be responsible for all work reasonably required under this SECTION Specification Heading.

The work involved under this SECTION shall include, but not necessarily be limited to, the following:

- A. Exterior composite windows.
- B. Insulating glass at all windows.
- C. All accompanying window hardware, sills, sealants, weather-stripping, and required accessories, etc., except as otherwise noted.
- D. Submittals.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Wood Blocking and Framing – SECTION 06 1000 – ROUGH CARPENTRY.
- B. Prefinished metal flashings, closures, and trim – SECTION 07 6200 – SHEET METAL FLASHING, AND ROOFING SPECIALTIES.
- C. Sealants – SECTION 07 9000 – JOINT PROTECTION.

- 1.4 WARRANTY – Windows shall have manufacturer's standard ten (10) year transferable limited warranty, and twenty (20) year transferable limited glass warranty.

2. PRODUCTS

- 2.1 GENERAL – The wood windows under this SECTION shall be by Andersen, 100 Series or approved equal. Windows shall have standard color as selected by Architect, manufacturer's standard 1" thick insulating glass (tempered as noted on the drawings) with low-E and argon gas air space, and jamb/head/sill extensions as required. See drawings for window sizes.
- 2.2 WINDOWS – Shall be Casement, as shown on the drawings.

3. EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's instructions and recommendations for installation of composite window units, hardware, accessories, and other components of work.
- B. Set units plumb, level, and true to line, without warp or rack of frames of sash. Provide

proper support and anchor securely in place.

3.2 ADJUST AND CLEAN

- A. Adjust operating sash and hardware to provide smooth operation with tight, weatherproof closure. Lubricate hardware and moving parts.
- B. Clean glass of window units promptly after installation; comply with requirements of "Glass and Glazing" Section for cleaning and maintenance.
- C. Protection – Provide as required through remainder of construction period, to ensure that wood window units will be without damage or deterioration (other than normal weathering) at time of acceptance.

END OF SECTION 08 5400

DIVISION 01 – GENERAL REQUIREMENTS

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
 - 1. Swinging doors.
- B. Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
 - 2. Electromechanical door hardware.
 - 3. Cylinders specified for doors in other sections.
- C. Related Sections:
 - 1. Division 08 Section "Hollow Metal Doors and Frames".
 - 2. Division 08 Section "Aluminum-Framed Entrances and Storefronts".
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
 - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 - 2. ICC/IBC - International Building Code.
 - 3. NFPA 70 - National Electrical Code.
 - 4. NFPA 80 - Fire Doors and Windows.
 - 5. NFPA 101 - Life Safety Code.
 - 6. NFPA 105 - Installation of Smoke Door Assemblies.
 - 7. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
 - 1. ANSI/BHMA Certified Product Standards - A156 Series.
 - 2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
 - 3. ANSI/UL 294 - Access Control System Units.
 - 4. UL 305 - Panic Hardware.
 - 5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 - 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 - 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Warranty information for each product.
 - 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Shop Drawings: Details of electrified access control hardware indicating the following:
 - 1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
 - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
 - b. Complete (risers, point-to-point) access control system block wiring diagrams.

- c. Wiring instructions for each electronic component scheduled herein.
- 2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.
- D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- E. Informational Submittals:
 - 1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

1.4 CLOSEOUT SUBMITTALS

- A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.
- B. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) and as required in Division 01, Project Record Documents.

1.5 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
- C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware

Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
 - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
 - 2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- F. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.
- G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
 - 1. Function of building, purpose of each area and degree of security required.
 - 2. Plans for existing and future key system expansion.
 - 3. Requirements for key control storage and software.
 - 4. Installation of permanent keys, cylinder cores and software.
 - 5. Address and requirements for delivery of keys.
- H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
 - 1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
 - 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 - 3. Review sequence of operation narratives for each unique access controlled opening.
 - 4. Review and finalize construction schedule and verify availability of materials.
 - 5. Review the required inspecting, testing, commissioning, and demonstration procedures
- I. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.7 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.8 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Faulty operation of the hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 4. Electrical component defects and failures within the systems operation.
- C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Hardware shall not have any visible manufacturer names on exposed materials, except cylinders, when the door is in a closed position.

2.2 BUTT HINGES

- A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
 - 1. Quantity: Provide the following hinge quantity:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
 - 2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
 - 3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
 - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
 - 4. Hinge Options: Comply with the following:
 - a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for all out-swinging lockable doors.
 - 5. Manufacturers:
 - a. McKinney (MK) - TA/T4A Series, 5-knuckle.

2.3 CONTINUOUS HINGES

- A. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 continuous geared hinge. with minimum 0.120-inch thick extruded 6063-T6 aluminum alloy hinge leaves

and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Where specified, provide modular continuous geared hinges that ship in two or three pieces and form a single continuous hinge upon installation.
2. Manufacturers:
 - a. Pemko (PE).

2.4 POWER TRANSFER DEVICES

- A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.
 1. Manufacturers:
 - a. Pemko (PE) - EL-CEPT Series.
 - b. Securitron (SU) - EL-CEPT Series.
- B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.
 1. Provide one each of the following tools as part of the base bid contract:
 - a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
 - b. McKinney (MK) - Connector Hand Tool: QC-R003.
 2. Manufacturers:
 - a. McKinney (MK) - QC-C Series.

2.5 DOOR OPERATING TRIM

- A. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Pulls, where applicable, shall be provided with a 10" clearance from the finished floor on the push side to accommodate wheelchair accessibility.
5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets. When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
6. Manufacturers:
 - a. Rockwood (RO).

2.6 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:
 1. Threaded mortise cylinders with rings and cams to suit hardware application.
 2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
 4. Tubular deadlocks and other auxiliary locks.
 5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
 6. Keyway: Manufacturer's Standard.
- C. Keying System: Each type of lock and cylinders to be factory keyed.
 1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
 2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
 3. New System: Key locks to a new key system as directed by the Owner.
- D. Key Quantity: Provide the following minimum number of keys:
 1. Change Keys per Cylinder: Two (2)
 2. Master Keys (per Master Key Level/Group): Five (5).
 3. Construction Keys (where required): Ten (10).

- E. Construction Keying: Provide construction master keyed cylinders.
- F. Key Registration List (Bitting List):
 - 1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
 - 2. Provide transcript list in writing or electronic file as directed by the Owner.

2.7 KEY CONTROL

- A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
 - 1. Manufacturers:
 - a. Lund Equipment (LU).
 - b. MMF Industries (MM).
 - c. Telkee (TK).

2.8 CYLINDRICAL LOCKS AND LATCHING DEVICES

- A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Operational Grade 1 Certified Products Directory (CPD) listed cylindrical locksets. Listed manufacturers shall meet all functions and features as specified herein.
 - 1. Manufacturers:
 - a. ASSA ABLOY ACCENTRA (YA) - 5400LN Series.

2.9 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
 - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 - 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 - 3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
 - 4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.
- B. Standards: Comply with the following:
 - 1. Strikes for Mortise Locks and Latches: BHMA A156.13.
 - 2. Strikes for Bored Locks and Latches: BHMA A156.2.

3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.10 CONVENTIONAL EXIT DEVICES

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
 1. Exit devices shall have a five-year warranty.
 2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
 3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
 4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
 5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
 6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
 - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
 - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
 7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
 8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
 9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
 10. Rail Sizing: Provide exit device rails factory sized for proper door width application.
 11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Commercial Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed exit devices. Listed manufacturers shall meet all functions and features as specified herein. Listed manufacturers shall meet all functions and features as specified herein.
 1. Provide locksets with functions and features as follows:

- a. Where required by code, provide knurling or abrasive coating on all levers leading to hazardous areas.
 - b. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.
 - c. Five-year limited warranty for mechanical features.
2. Manufacturers:
- a. ASSA ABLOY ACCENTRA (YA) - 6000 Series.

2.11 SURFACE DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
- 1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
 - 2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
 - 3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
 - 4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
 - 5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
 - 6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
- 1. Heavy duty surface mounted door closers shall have a 30-year warranty.
 - 2. Manufacturers:
 - a. Norton Rixson (NO) - 7500 Series.
- C. Door Closers, Surface Mounted (Commercial Duty): ANSI/BHMA 156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, institutional grade door

closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck, closing sweep, and latch speed control valves. Provide non-handed units standard.

1. Manufacturers:
 - a. Norton Rixson (NO) - 8500 Series.

2.12 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:
 - a. Stainless Steel: 300 grade, 050-inch thick.
5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:
 - a. Rockwood (RO).

2.13 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 1. Manufacturers:

- a. Rockwood (RO).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
 - 1. Manufacturers:
 - a. Norton Rixson (RF).
 - b. Sargent Manufacturing (SA).

2.14 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Manufacturers:
 - 1. Pemko (PE).

2.15 ELECTRONIC ACCESSORIES

- A. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and

magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.

1. Manufacturers:
 - a. Securitron (SU) - DPS Series.

2.16 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.17 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
- E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

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.

3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
 1. Quantities listed are for each pair of doors, or for each single door.
 2. The supplier is responsible for handing and sizing all products.
 3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
 4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.
- B. Manufacturer's Abbreviations:

1. MK - McKinney
2. PE - Pemko
3. SU - Securitron
4. RO - Rockwood
5. YA - ASSA ABLOY ACCENTRA
6. RF - Rixson
7. NO - Norton
8. OT - Other

Hardware Sets

Set: 1.0

Doors: 101A

2 Continuous Hinge	KDFM83-HD1 PT x Height Required		PE
2 Electric Power Transfer	EL-CEPT	613E	SU
1 Rim Exit Device, Nightlatch	6200 B MELR 121NL 1109 x 6-Pin	613E	YA
1 Rim Exit Device, Exit Only	6200 B MELR EO	613E	YA
2 Pull	RM201 Mtg-Type 1XHD	10BE	RO
2 Conc Overhead Stop	1-x36	613E	RF
2 Surface Closer	PR7500	690	NO
2 Drop Plate	7788	690	NO
2 Blade Stop	6891	690	NO
2 Gasketing	Provided by Alum. Door Supplier		OT
2 Sweep	3452DNB TKSP		PE
2 Threshold	253x3DFG		PE
2 ElectroLynx Harness	QC-C1500P (Frame - EPT to Power/Controller)		MK
2 ElectroLynx Harness	QC-CxxxP (Door - EPT to Elec. Exit Device)		MK
2 Position Switch	DPS-M / W		SU
1 Card Reader / Keypad	Provided by Security Contractor		OT
1 Power Supply	Provided by Security Contractor		OT

Notes: Door normally closed, latched and secured.

Entry by pulls when doors electrically dogged open by access control system, valid card read / pin code or key override.

Free egress at all times.

Fixed mullion provided with aluminum frame.

Set: 2.0

Doors: 102A

2 Continuous Hinge	KDFM83-HD1 PT x Height Required		PE
2 Electric Power Transfer	EL-CEPT	613E	SU
1 Rim Exit Device, Nightlatch	6200 B MELR 121NL 1109 x 6-Pin	613E	YA
1 Rim Exit Device, Exit Only	6200 B MELR EO	613E	YA
2 Pull	RM201 Mtg-Type 1XHD	10BE	RO
2 Conc Overhead Stop	1-x36	613E	RF
2 Surface Closer	PR7500	690	NO
2 Drop Plate	7788	690	NO
2 Blade Stop	6891	690	NO
2 ElectroLynx Harness	QC-C1500P (Frame - EPT to Power/Controller)		MK
2 ElectroLynx Harness	QC-CxxxP (Door - EPT to Elec. Exit Device)		MK
2 Position Switch	DPS-M / W		SU
1 Card Reader / Keypad	Provided by Security Contractor		OT
1 Power Supply	Provided by Security Contractor		OT

Notes: Door normally closed, latched and secured.

Entry by pulls when doors electrically dogged open by access control system, valid card read / pin code or key override.

Free egress at all times.

Fixed mullion provided with aluminum frame.

Set: 3.0

Doors: 106B, 109B, 112B

1 Continuous Hinge	KDFM83-HD1 x Height Required		PE
1 Finger Protection	FSR6000BL82 82	BL	PE
1 Rim Exit Device, Exit Only, Alarmed	6200 A EO 2153 x 6-Pin	613E	YA
1 Conc Overhead Stop	1-x36	613E	RF
1 Surface Closer	PR7500	690	NO
1 Drop Plate	7788	690	NO
1 Blade Stop	6891	690	NO

1 Gasketing	Provided by Alum. Door Supplier		OT
1 Sweep	3452DNB TKSP		PE
1 Threshold	253x3DFG		PE
1 Position Switch	DPS-M / W		SU

Notes: Door normally closed, latched and secured.
No entry - exit only door but local alarm will sound.
Free egress at all times.

Set: 4.0

Doors: 118B, 121B, 124B, 128B

1 Continuous Hinge	KDFM83-HD1 x Height Required		PE
1 Finger Protection	FSR6000BL82 82	BL	PE
1 Rim Exit Device, Classroom	6200 AU506F 1109 x 6-Pin	613E	YA
1 Conc Overhead Stop	1-x36	613E	RF
1 Surface Closer	PR7500	690	NO
1 Drop Plate	7788	690	NO
1 Blade Stop	6891	690	NO
1 Gasketing	Provided by Alum. Door Supplier		OT
1 Sweep	3452DNB TKSP		PE
1 Threshold	253x3DFG		PE
1 Position Switch	DPS-M / W		SU

Notes: Door normally closed, latched and secured.
Entry by lever when unlocked by key.
Free egress at all times.

Set: 5.0

Doors: 102C

1 Continuous Hinge	KDFM83-HD1 PT x Height Required		PE
1 Electric Power Transfer	EL-CEPT	613E	SU
1 Rim Exit Device, Nightlatch	6200 B MELR 121NL 1109 x 6-Pin	613E	YA
1 Pull	RM201 Mtg-Type 1XHD	10BE	RO
1 Conc Overhead Stop	1-x36	613E	RF
1 Surface Closer	PR7500	690	NO
1 Drop Plate	7788	690	NO
1 Blade Stop	6891	690	NO
1 Gasketing	Provided by Alum. Door Supplier		OT

1 Sweep	3452DNB TKSP	PE
1 Threshold	253x3DFG	PE
1 ElectroLynx Harness	QC-C1500P (Frame - EPT to Power/Controller)	MK
1 ElectroLynx Harness	QC-CxxxP (Door - EPT to Elec. Exit Device)	MK
1 Position Switch	DPS-M / W	SU
1 Card Reader / Keypad	Provided by Security Contractor	OT
1 Power Supply	Provided by Security Contractor	OT

Notes: Door normally closed, latched and secured.
Entry by valid card read / pin code or key override.
Free egress at all times.

Set: 6.0

Doors: 117B

1 Continuous Hinge	CFM83HD1-M x Height Required	PE
1 Storeroom Lock	AU 5405LN	626 YA
1 Surf Overhead Hold Open	9-x26	630 RF
1 Surface Closer	PRO 7500	689 NO
1 Kick Plate	K1050 10" x 2" LDW CSK BEV	US32D RO
1 Gasketing	2891APK TKSP8	PE
1 Sweep	3452CNB TKSP8	PE
1 Threshold	253x3AFG	PE

Notes: Door normally closed, latched and secured.
Entry by key override.
Free egress at all times.

Door can be manually held open by overhead holder.

Install gasketing prior to soffit mounted hardware. Do not notch gasketing for soffit mounted hardware.

Set: 7.0

Doors: 116A

3 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D MK
1 Classroom Lock	AU 5408LN	626 YA
1 Surf Overhead Hold Open	9-x26	630 RF
1 Surface Closer	8501	689 NO

1 Kick Plate	K1050 10" x 2" LDW CSK BEV	US32D	RO
3 Silencer	608-RKW		RO

Notes: Door can be manually held open by overhead holder.

Set: 8.0

Doors: 106A, 109A, 112A, 118A, 121A, 124A, 128A

1 Continuous Hinge	CFM83HD1-M x Height Required		PE
1 Finger Protection	FSR6000C82 82	C	PE
1 Classroom Lock	AU 5408LN	626	YA
1 Surface Closer	8501	689	NO
1 Wall Stop	400 / 403	US26D	RO
3 Silencer	608-RKW		RO

Set: 9.0

Doors: 114A

3 Hinge, Full Mortise	TA2714 4-1/2" x 4-1/2"	US26D	MK
1 Storeroom Lock	AU 5405LN	626	YA
1 Wall Stop	400 / 403	US26D	RO
3 Silencer	608-RKW		RO

Set: 10.0

Doors: 104A, 127A

3 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Storeroom Lock	AU 5405LN	626	YA
1 Surface Closer	8501	689	NO
1 Wall Stop	400 / 403	US26D	RO
3 Silencer	608-RKW		RO

Set: 11.0

Doors: 111A, 115A, 119A, 123A

1 Continuous Hinge	CFM83HD1-M x Height Required		PE
1 Finger Protection	FSR6000C82 82	C	PE
1 Storeroom Lock	AU 5405LN	626	YA
1 Wall Stop	400 / 403	US26D	RO
3 Silencer	608-RKW		RO

Set: 12.0

Doors: 108A, 127B, 127C

1 Continuous Hinge	CFM83HD1-M x Height Required		PE
1 Finger Protection	FSR6000C82 82	C	PE
1 Storeroom Lock	AU 5405LN	626	YA
1 Surf Overhead Stop	9-x36	630	RF
3 Silencer	608-RKW		RO

Set: 13.0

Doors: 103A

3 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Entry Lock	AU 5407LN	626	YA
1 Surface Closer	8501	689	NO
1 Wall Stop	400 / 403	US26D	RO
3 Silencer	608-RKW		RO

Set: 14.0

Doors: 117A

3 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Passage Set	AU 5401LN	626	YA
1 Surface Closer w/ Hold Open	CPS8501T	689	NO
1 Wall Stop	400 / 403	US26D	RO
3 Silencer	608-RKW		RO

Set: 15.0

Doors: 105A

3 Hinge, Full Mortise, Hvy Wt	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1 Privacy Set	AU 5402LN	626	YA
1 Surface Closer	8501	689	NO
1 Wall Stop	400 / 403	US26D	RO
3 Silencer	608-RKW		RO

Set: 16.0

Doors: 107A, 110A, 113A, 125A, 126A

1 Continuous Hinge	CFM83HD1-M x Height Required		PE
1 Finger Protection	FSR6000C82 82	C	PE
1 Privacy Set	AU 5402LN	626	YA
1 Surface Closer	8501	689	NO
1 Wall Stop	400 / 403	US26D	RO
3 Silencer	608-RKW		RO

Set: 17.0

Doors: 129A, 129B

1 Continuous Hinge	CFM83HD1-M x Height Required		PE
1 Finger Protection	FSR6000C82 82	C	PE
1 Push Plate	70C-RKW	US32D	RO
1 Pull Plate	BF 111x70C	US32D	RO
1 Surface Closer	8501	689	NO
1 Wall Stop	400 / 403	US26D	RO
3 Silencer	608-RKW		RO

Mark	Hardware
101A	1.0
102A	2.0
102C	5.0
103A	13.0
104A	10.0
105A	15.0
106A	8.0
106B	3.0
107A	16.0
108A	12.0
109A	8.0
109B	3.0
110A	16.0

111A	11.0
112A	8.0
112B	3.0
113A	16.0
114A	9.0
115A	11.0
116A	7.0
117A	14.0
117B	6.0
118A	8.0
118B	4.0
119A	11.0
121A	8.0
121B	4.0

123A	11.0
124A	8.0
124B	4.0
125A	16.0
126A	16.0
127A	10.0
127B	12.0
127C	12.0
128A	8.0
128B	4.0
129A	17.0
129B	17.0

END OF SECTION 087100

DIVISION 08 – OPENINGS

SECTION 08 8000 – GLAZING

1. GENERAL

- 1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.
- 1.2 SCOPE – Furnish all labor, materials, and equipment required to complete all Glazing Work shown on the drawings and as herein specified. The Contractor will be responsible for all work reasonably required under this SECTION Specification Heading.

The work involved under this SECTION shall include, but not necessarily be limited to the following:

- A. Glass and glazing of all aluminum frame entrance doors.
 - B. Glass and glazing of all exterior windows and storefronts.
 - C. Glass and glazing for all interior doors.
 - D. Glass and glazing for interior windows.
 - E. Cleaning.
 - F. Samples.
 - G. Warranty.
- 1.3 RELATED WORK SPECIFIED ELSEWHERE
- A. Glass for Hollow Metal Doors and Frames – SECTION 08 1113 – HOLLOW METAL DOORS AND FRAMES.
 - B. Glass and Glazing of Aluminum Doors & Windows – SECTION 08 4113 – ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.
- 1.4 BUILDING CODE COMPLIANCES – Safety glazing, meeting the requirements of Federal Specification DD-G-1403B, ANSI Z97.1-Latest Edition, and CPSC 16 CFR 1201, shall be installed in all locations as required by the building codes in place for the location of the project.
- 1.5 WARRANTY – Contractor shall provide a Certificate of Guarantee to the Owner for insulating glass. For ten (10) years from date of manufacture, the manufacturer shall deliver free of charge, a replacement of any unit which develops material obstructions of vision between glass surfaces.

2. PRODUCTS

- 2.1 CLEAR TEMPERED GLASS – Shall be tempered safety glass, ¼” thickness, meeting the requirements of Federal Specification DD-G-1403B, ANSI Z97.1-Latest Edition, and CPSC 16 CFR 1201. Exposed edges shall be machine ground and polished.
- 2.2 INSULATING GLASS – 1” metal edge insulating Low E glass units with ¼” clear polished plate on interior and exterior with ½” air space. Ten (10) year guarantee required.

- 2.3 TEMPERED INSULATING GLASS – 1" metal edge insulating Low E glass units with ¼" clear tempered polished plate on interior and exterior with ½" air space. Tempered safety glass shall meet the requirements of Federal Specification DD-G-1403B, ANSI Z97.1-Latest Edition, and CPSC 16 CFR 1201. Ten (10) year guarantee required.
- 2.4 STANDARD GLASS OR GLASS NOT OTHERWISE SPECIFIED – Shall be ¼" sheet glass, Federal Spec. DD-G451A.
- 2.5 NEOPRENE GLAZING – Shall be equal to Neoprene sheeting material approximately 1/8" thick or other pre-molded neoprene channels as approved by the Architect.
- 2.6 GLAZING COMPOUND TAPES – Shall be "Tremglaze" as made by Tremco Manufacturing Company, Cleveland, OH.
- 2.7 APPROVED MANUFACTURERS – Other approved manufacturers using products equal to or exceeding the specified items.

3. EXECUTION

3.1 GLASS SETTING

- A. ALUMINUM FRAMES – Glass shall be installed in strict accordance with the door and frame manufacturer's direction in neoprene strips and seals furnished by the frame manufacturer.

3.2 GLASS DISTRIBUTION – See Notes on Elevations, Details, and Schedules for type of glass in openings.

3.3 IDENTIFYING GLASS LABEL – Is to be furnished with all glass, and is to remain until removed as directed by the Owner's Representative.

3.4 WORKMANSHIP – All glazing will be done only by experienced glazers with glass completely surrounded by glazing. Gaps in the compound will not be permitted and all work will be accomplished in full accordance with the glass manufacturer's written instructions.

3.5 CLEANING – Work under this SECTION includes complete cleaning of all glass, inside and out, removal of labels after Architect's approval including cleaning of frames. Solutions of cleaners to be used must be approved and of a nature that is not harmful to building materials, frames, etc.

END OF SECTION 08 8000

DIVISION 09 – FINISHES

SECTION 09 2116 – GYPSUM BOARD ASSEMBLIES

1. GENERAL

- 1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.
- 1.2 SCOPE – Furnish all labor, materials, and equipment and accessories to complete all Gypsum Board Work as shown on the drawings, room schedule, and as herein specified. The Contractor will be responsible for providing all work that is reasonably required under this SECTION Specification Heading.

The work involved under this SECTION shall include, but not necessarily be limited to, the following:

- A. Interior gypsum board.
- B. Joint treatment.
- C. Other required accessories.
- D. Cleaning-up and Protection.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Metal Framing – SECTION 05 4000 – COLD-FORMED METAL FRAMING.
- B. Wood Framing – SECTION 06 1000 – ROUGH CARPENTRY.
- C. Firestopping Walls – SECTION 07 8000 – FIRE AND SMOKE PROTECTION.
- D. Sealants – SECTION 07 9000 – JOINT PROTECTION.

2. PRODUCTS

- 2.1 GYPSUM BOARD AND ACCESSORIES – Shall be a complete system including all items needed for a fully complete installation, equal to that as manufactured by and installed as recommended by U.S.G., including but not limited to, the following:
- A. Interior gypsum board – USG tapered edges 5/8" thick "Firecode X - Sheetrock"; or approved equal. Furnish fire-rated throughout.
 - B. Gypsum Liner Panels – USG Sheetrock brand (UL Type SLX), 1" x 24" with beveled edges.
 - C. Adhesive – USG recommended adhesive, or approved equal.
 - D. Exterior gypsum board – USG "Sheetrock", or approved equal. 5/8" thick "Firecode" core, water-repellent paper on both sides and long edges.
 - E. Metal edge trim, metal corner bead, accessories at all corners, terminations, junctures, etc. and as detailed.
 - F. Joint treatment – U.S.G. recommended joint treatment, or approved equal.

G. Fasteners – Bugle head screws, type and length as recommended by manufacturer.

3. EXECUTION

- 3.1 GENERAL – Gypsum Board, framing system, and other Gypsum Board Work shall be as specified and shown on the drawings and as required and fastened in accordance with the manufacturer's current best standards. Accessories such as edge mold, corner bead, etc., as detailed shall be included and installed. Joint treatment, taping, and spotting of fasteners shall be in accordance with the manufacturer's current best standards. The Contractor shall be held solely liable for the proper performance of the total systems used and compatibility of the products assembled.
- 3.2 EXPOSED – FINISHED GYPSUM BOARD PANELS – Apply gypsum board panels with the long dimensions at right angles to the framing with 1" drywall screws at 12" o.c. in the field and edges. Finish smooth to accept paint.
- 3.3 CONCEALED – UNFINISHED GYPSUM BOARD PANELS – Apply gypsum board panels with long dimensions at right angles to the framing with 1" drywall screws at 12" o.c. in the field and edges. All joints shall be reinforced with paper tape in joint compound and spot cement fasteners. Fire tape all joints and spot cement fasteners at fire-rated walls.
- 3.4 JOINT TREATMENT – All exposed panels except pre-finished, shall have all joints, corners, angles, edges, trim, etc. with USG Joint System installed according to the manufacturer's directions. Spot exposed fasteners on face layers and finish corner bead, control joints, trim, etc. as required with at least three (3) coats of joint compound - feather out onto panel faces and sanded smooth.
- 3.5 WORKMANSHIP – The Contractor must be skilled and experienced in the installation of Gypsum Drywall and use skilled, experienced mechanics. He shall be held responsible for furnishing a complete, finished system ready for painting or other finishing.

END OF SECTION 09 2116

DIVISION 09 – FINISHES

SECTION 09 5123 – ACOUSTICAL TILE CEILINGS

1. GENERAL

- 1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.
- 1.2 SCOPE – Furnish all labor, materials, equipment and accessories required to complete all Acoustical Tile Ceiling Work, as shown on the drawings, as indicated on the Room Schedule and as herein specified. The Contractor will be responsible for all work reasonably required under this SECTION Specification Heading.

The work involved under this Section shall include, but not necessarily be limited to, the following items:

- A. Suspended Acoustical Ceiling Tile.
 - B. Suspended Vinyl Covered Ceiling Tile.
 - C. Metal Grid Suspension System, grid, and accessories.
 - D. Cleaning and Protection.
 - E. Submittals.
 - F. Warranty.
- 1.3 SUBMITTALS – The Acoustical Ceiling Subcontractor is to submit for approval, shop drawings in accordance with SECTION 01 3300 – SUBMITTAL REQUIREMENTS. They shall have complete information regarding the size and spacing and layout of all members in connection with the suspension system and shall show the layout of all suspension system members for all areas and shall show coordination with lights, partitions, diffusers, etc.
- 1.4 WARRANTY – All materials and workmanship furnished under this Contract shall be guaranteed by the Acoustical Subcontractor for a period of one (1) year from total contract final payment date, and on written demand by the Architect within that period, any defective materials or workmanship shall be replaced or corrected by the Acoustical Subcontractor at his expenses. Additionally, ceiling tile shall have a ten (10) year guarantee for visible sag.

2. PRODUCTS

2.1 CEILING TILES

- A. NON-RATED ACOUSTIC CEILING TILE – Shall be Armstrong No. 1729, Fine Fissured RH90 or USG No. 2210 Radar; 24" x 24" x 5/8", white color.
- B. VINYL COVERED CEILING TILE – Shall be Endure Vinyl-Gyp Ceiling Panels by Chicago Metallic or approved equal; 24" x 48", white color.

2.2 SUSPENSION SYSTEMS

- A. NON-RATED METAL GRID SUSPENSION SYSTEM – Shall be Armstrong Prelude XL, or USG Donn DX/DXL, white color.

3. EXECUTION

- 3.1 LAY-IN SUSPENSION SYSTEM – The Lay-in Panel Suspension System shall be a T-Bar Type Suspended Grid with 24" x 24" grid patterns. Main Runners shall be spaced 48" o.c. and hung from the roof structure with No. 12 SWG galvanized wire, spaced at 48" maximum along the runner. To complete the 24" x 24" grid, Cross Tee Splines shall be installed between the Main Tee Runners as required. Grid shall be installed strictly in accordance with the manufacturer's directions, and be of a weight, standard or structural, as required to support lights, diffusers, etc. Provide extra hangers where required.

3.2 WORKMANSHIP

- A. The installation shall be made by an Acoustical Subcontractor approved by the manufacturer.
- B. Work required includes all labor, materials, equipment and service necessary to install the panels on ceilings of areas as indicated on the drawings, and/or the Room Finish Schedule. He shall be responsible for installation of required hangers during the other phases of the construction.
- C. No work is to be started until all glazing has been completed and all exterior openings closed in. All wet work, including cement, gypsum board, etc. shall be completed and dried out to the satisfaction of the Architect before work is started. Temporary or permanent heat shall be furnished by others to provide uniform temperatures of at least 60 degrees F before, during, and after installation of Acoustical Tile.
- D. The Acoustical Subcontractor shall be responsible for the examination and acceptance of all surfaces and conditions affecting the proper installation of his materials, and shall not proceed until all unsatisfactory conditions have been corrected by others.
- E. Before delivering any materials to the job site, the Acoustical Subcontractor shall obtain written approval of all material samples and methods of installation.
- F. All workmanship under this SECTION shall be of the highest quality, done by skilled mechanics thoroughly trained in their work. Finished work to be accepted must be clean, free of mars, straight, level and true. Joints shall be clean and precise.

END OF SECTION 09 5123

DIVISION 09 – FINISHES

SECTION 09 6500 – RESILIENT FLOORING

1. GENERAL

- 1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.
- 1.2 SCOPE – Furnish all labor, materials, equipment, and accessories to complete all Resilient Flooring and Base Work as shown on the drawings, room schedule, and as herein specified. The Contractor will be responsible for providing all work that is reasonably required under this SECTION Specification Heading.
- The work involved under this SECTION shall include, but not necessarily be limited to, the following:
- A. Vinyl Base.
 - B. Transition Edges.
 - C. Luxury Vinyl Tile Flooring
- 1.3 WARRANTY – All work is to be guaranteed for a period of one (1) year against material defects and faulty workmanship including loosening of material.
- 1.4 SUBMITTALS – Submit Shop Drawings of the flooring in accordance with SECTION 01 3300 – SUBMITTAL REQUIREMENTS.

2. PRODUCTS

- 2.1 VINYL BASE – Shall be by Johnsonite, Armstrong, or approved equal. Base shall be 4" high x 1/8" thick, roll stock, coved, with preformed outside corners, installed with manufacturer's recommended adhesive. Standard color as selected by Architect.
- 2.2 VINYL TRANSITION EDGES – Shall be by Johnsonite, or approved equal. Provide a smooth transition between different surfaces. Standard color as selected by Architect.
- 2.3 LUXURY VINYL TILE FLOORING – Shall be as indicated on the drawings.
- 2.4 ADHESIVE
- A. GENERAL – For all installation under this Section will be fully in accordance with manufacturer's recommendations for the installation contemplated.
 - B. LUXURY VINYL TILE FLOORING ADHESIVE – Shall be as recommended by the tile manufacturer.

3. EXECUTION

- 3.1 VINYL BASE INSTALLATION – The vinyl base is to be firmly and thoroughly cemented to the wall with proper adhesive such that the top of the base will be uniform straight line

above the floor.

- 3.2 VINYL SUBFLOOR LEVELER – Shall occur at the transition between different floorings. Install according to manufacturer's instructions and recommendations. All transitions between different floorings shall be concealed and provide a smooth transition.
- 3.3 VINYL TRANSITION EDGE INSTALLATION – Shall occur at the transition between different floorings and floorings and concrete slabs. Install according to manufacturer's instructions and recommendations.
- 3.4 LUXURY VINYL TILE FLOORING INSTALLATION
- A. GENERAL
1. The floors shall be clean and free from all foreign matter and thoroughly dry before installation of planks.
 2. The Flooring Contractor shall fill all cracks, defects, roughness, etc., with flooring manufacturer's recommended filler or approved equal to level, smooth other work as necessary to properly prepare the floors to receive new planks.
 3. Lay planks symmetrically about axis lines of areas with no planks less than ½" width, straight joints, parallel to walls with all joints tight and all planks finishing flush with other adjoining flooring materials.
 4. Fit planks neatly around all permanent fixtures.
 5. Planks shall be installed under base cabinets.
- B. LUXURY VINYL TILE – Shall be directly adhered. Install according to the manufacturer's recommendations and requirements.
- 3.5 CLEANING – Clean surplus adhesive off floors, walls, etc. immediately after laying. Clean thoroughly the entire floor and base surfaces to remove all dirt, scuff marks, etc.
- 3.6 WORKMANSHIP – All work shall be in accordance with the manufacturer's recommendations for preparation, adhesive, laying of material and cleaning. Work shall be done by skilled mechanics trained in their trade and in the best trade practice. Cover as necessary to protect finish flooring. Replace any damaged work.

END OF SECTION 09 6500

DIVISION 09 – FINISHES

SECTION 09 6723 – RESINOUS FLOORING

1. GENERAL

1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.

1.2 SCOPE – Furnish all labor, materials, equipment and accessories to complete all Resinous Flooring and Base Work as shown on the drawings, room schedule, and as herein specified. The Contractor will be responsible for providing all work that is reasonably required under this SECTION Specification Heading.

The work involved under this SECTION shall include, but not necessarily be limited to, the following:

- A. Epoxy Resin Flooring.
- B. Submittals.

1.3 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Obtain Epoxy Coating System materials from a single manufacturer with a minimum of ten (10) years verifiable experience providing materials of the type specified in this section.
- B. Contractor's Qualifications: Installation must be performed by a manufacturer approved contractor with skilled mechanics having not less than five (5) satisfactory experiences in the installation of the type of system as specified in this section, and must be approved in writing by the manufacturer of the Epoxy Coating System.

1.4 WARRANTY

- A. The contractor and the manufacturer shall furnish a standard guarantee of the Epoxy Coating System for a period of one year after installation. The labor and material guarantee shall include loss of bond and wear-through to the concrete substrate from normal use.
- B. Not included in the warranty are damage due to structural design deficiencies including but not limited to slab cracking from lateral, vertical or rotational movement, and gouging or other damage due to fork lifts, other equipment, delamination caused by vapor transmission, Acts of God, or other elements beyond the scope of protection of this system nor causes not related to the system materials.

1.5 SUBMITTAL

- A. System Data: Submit manufacturer's specifications on cured system and individual components of the Epoxy Coating System, including physical properties and performance properties and tests described herein and submit Material Safety Data Sheets. Each individual component of the system will be evaluated on the basis of these

standards. For any tests not listed in the manufacturer's standard nationally published data, the manufacturer must supply the missing data accompanied by the independent testing laboratory's test results which prove compliance in accordance with the referenced standard(s). Manufacturer's standard color chart shall also be submitted and must afford the owner color selection from standard colors and computerized custom color matching shall be available upon request.

- B. The contractor shall submit two (2) 12" x 12" cured system samples which the contractor has made for verification purposes and finish texture approval.
- C. Contractor Experience: The contractor shall furnish a list of projects using either specified material or equivalent that they have installed during the last three (3) years. Information shall include: project name, square footage, owner contact name with owner's address and phone number. Also, the contractor shall furnish résumés detailing the experience of key project personnel including supervisors and mechanics.
- D. It is the intention of this Section to provide the products as named. Substitutions will be considered only when received by the Architect as stipulated in Section 00 2000 Instructions to Bidders. Upon receipt of any such submission, the Architect, Engineer or Design Professional will determine whether or not the proposed product is an equal. No substitutions will be considered after contract bid date.
- E. The contractor shall submit a copy of the manufacturer's packing slip, tagged for this specific job, along with calculations, signed by an officer of the primary material supplier demonstrating that the quantity of material furnished for the project will achieve the specified coverage and mil thickness.

1.6 MATERIAL DELIVERY, HANDLING, AND STORAGE

- A. Primary system materials shall be delivered in the manufacturer's undamaged, unopened containers. Each container shall be clearly marked with the following:
 - 1. Product name(s) and/or Number(s)
 - 2. Manufacturer's name
 - 3. Component designation (A, B, etc.)
 - 4. Product Mix Ratio
 - 5. Health and Safety Information
 - 6. CHEMTREC Emergency Response Information
- B. Provide equipment and personnel to handle the materials by methods which prevent damage.
- C. The contractor shall promptly inspect direct jobsite material deliveries to assure that quantities are correct, comply with requirements and are not damaged.
- D. The contractor shall be responsible for materials furnished by him, and he shall replace, at his own expense, such materials that are found to be defective in manufacture or that have become damaged in transit, handling or storage.
- E. Store material(s) in accordance with manufacturer's instructions, with seals and labels intact and legible. Maintain temperatures within the required range. Do not use materials which exceed the manufacturer's maximum recommended shelf life.

1.7 JOB CONDITIONS

- A. The contractor shall visit the jobsite prior to the installation of the Epoxy Coating System to evaluate substrate condition, including substrate moisture transmission, quantity and severity of cracking, and the extent of repairs needed. Substrate imperfections should be repaired only after mechanical preparation of the substrate. Surface preparation reveals most imperfections requiring repair. Concrete substrates shall be tested to verify that the moisture vapor transmission of the substrate does not exceed the Epoxy Coating System manufacturers' recommendations. Cost associated with repair, leveling and remediation of the substrate are the responsibility of the provider of the substrate.
- B. The contractor should exercise care during surface preparation and system installation to protect surrounding substrates and surfaces, as well as in-place equipment. The contractor shall prepare the substrate to remove laitance and open the surface. This shall be achieved by light brush grit blasting. Surface profile achieved shall be similar to medium grit sandpaper and free from bond-inhibiting contaminants. Costs incurred that are associated with damage from negligence or inadequate protection shall be the sole responsibility of the contractor.
- C. Sub floor tolerances shall be in accordance with ACI 302. Each drain in the installation area must be working and raised or lowered to the actual finished elevation of the Epoxy Coating System.
- D. System must be protected by the General Contractor or by the installing contractor until it is inspected and turned over to the owner.
- E. The minimum slab temperature must be conditioned to 60 degrees F before commencing installation, during installation, and for at least 72 hours after installation is complete. The substrate temperature must be at least 5 degrees F above the dew point during installation.
- F. Maintain lighting at a minimum uniform level of 50 or more foot candles in areas where the Epoxy Coating System is being installed. It is the recommendation of the manufacturer that the permanent lighting be in place and working during the installation.
- G. Leaks from pipes and other sources must be corrected prior to the installation of the Epoxy Coating System.

2. **PRODUCTS**

- 2.1 APPROVED MANUFACTURERS – Shall be General Polymers, a division of The Sherwin Williams Company, or approved equal. Prior to bidding, equal manufacturers shall comply with the requirements of this specification.

2.2 MATERIALS

- A. System Overview – The General Polymers Decorative Mosaic Epoxy Coating System as manufactured by Sherwin-Williams consists of
 - 1. 3579 Standard Primer
 - 2. 3745 Self-Leveling Epoxy as base coat
 - 3. 6750/6755 Decorative Vinyl Chip Aggregate.

4. 4638 HS Polyurethane Floor Enamel seal coat

B. Typical Physical Properties

1. Abrasion Resistance (ASTM D 4060, CS-17 Wheel, 1,000 cycles): 100 mgs lost
2. Flexural Strength (ASTM C 580): 10,000 psi
3. Adhesion (ACI 503R): 300 psi concrete failure
4. Flammability: Self-extinguishing over concrete
5. Impact Resistance (MIL-D-3134J): Direct, inch pound greater than 160, passes
Reverse, inch pound greater than 80, passes
6. Resistance Elevated Temperatures (MIL-D-3134J): No slip or flow at required temperature of 158°F

C. Color: Custom color chip blend as selected by the Architect.

3. EXECUTION

3.1 EXAMINATION – Examine concrete surface to receive floor coating system. Notify the Architect if surface is not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.

3.2 SURFACE PREPARATION – Prepare surface in accordance with manufacturer's instructions.

3.3 INSTALLATION – Apply each component of the Epoxy Coating System in compliance with manufacturer's written installation instructions and strictly adhere to mixing and installation methods, recoat windows, cure times and environmental restrictions. The Epoxy Coating System is to be installed directly over non-moving control joints and cracks which have been treated with EPO-FLEX epoxy, and the Epoxy Coating System will terminate at the edge of isolation and expansion joints as designated by the Architect.

3.4 CURING, CLEANING, AND PROTECTION

- A. Cure the Epoxy Coating System materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of the installation and prior to completion of the curing process.
- B. Protect the Epoxy Coating System from damage and wear during other phases of the construction operation, using temporary coverings as recommended by the manufacturer, if required. Remove temporary covering just prior to final inspection.
- C. Clean the Epoxy Coating System just prior to final inspection, using materials and procedures suitable to the system manufacturer.

END OF SECTION 09 6723

DIVISION 09 – FINISHES

SECTION 09 6800 – CARPETING

1. GENERAL

- 1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.
- 1.2 SCOPE – Furnish all labor, materials, accessories and equipment required to complete, furnish and install all Carpet Work, as shown on the drawings as detailed, and as herein specified. The Contractor will be responsible for all work reasonably required under this SECTION Specification Heading.

The work involved under this Section shall include but not necessarily be limited to, the following items:

- A. Final Floor Preparation.
- B. Carpet, using direct glue-down method.
- C. Edge molding, fasteners, accessories, etc. as required.
- D. Samples, Certifications, Fire Rating Test Data, and Fire Authority Approvals.
- E. Maintenance Instructions.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Transition edging where carpet joins different flooring surfaces – SECTION 09 6500 – RESILIENT FLOORING.
- 1.4 SAMPLES – Submit in duplicate (2) samples of each carpet type in a minimum size of 12" x 12" accompanied by the manufacturer's specification on the construction of the carpet, the fire rating test and approval data by the Iowa State Fire Marshal of the carpet for installation in this building usage.
- 1.5 MEASUREMENT – The Contractor shall inspect the job site, check the original construction drawings, and shall be solely and fully be responsible for measuring and furnishing of the correct yardage necessary to completely install all of the carpet as shown on the schedule and drawings.
- 1.6 FIRE RATING – Carpets shall conform to the fire rating requirements of the State Fire Marshal and/or local fire authorities having jurisdiction with a written approval by such authorities. Current data indicates that these requirements for fire rating are as follows:
Flame Spread: 75 or less
Smoke Density: 150 or less

2. PRODUCTS

- 2.1 CARPET – Shall be as indicated on the drawings.
- 2.2 ADHESIVES – Products to be supplied with a pre-cured, mill-applied or other “dry” adhesive system when available. Otherwise, adhesive should be full spread, extremely

low VOC in compliance with CRI Indoor Air Quality Adhesive Testing Program requirements, compatible with materials being adhered, as recommended by the Manufacturer.

- 2.3 REPLACEMENT CARPET TILE – The Contractor shall provide the Owner with ten (10) minimum full size carpet tile for future replacement purposes.

3. EXECUTION

- 3.1 GENERAL – The installation shall be in a manner to anticipate a first-class appearance with durable and serviceable life. All materials shall be installed by a skilled workman under proper supervision. After installation is complete, the Subcontractor shall clean up all refuse and debris, remove all spots and stains from the carpet with the proper spot remover and the carpet shall then be thoroughly vacuumed. The Owner shall view carpet scraps and retain any he chooses for future repairs before they are removed from the job site. The Carpet Installer will be required to re-lay any carpet that does not provide an attractive, wrinkle-free appearance and shall correct any condition due to faulty installation or material which may appear for a period of one (1) year from the date of the final payment. Special care of installation shall be taken at all steps and risers to insure the durable and workmanlike appearance at these critical wear points.
- 3.2 DELIVERY AND STORAGE – All carpet shall be delivered to the job site in the original mill wrappings with each roll having its register number properly marked as soon as it is delivered to the job site. Protect from damage, dirt, stains and moisture.
- 3.3 FLOOR PREPARATION – The General Contractor shall leave the floors broom-clean and dry and in a condition satisfactory to the Carpet Contractor. The Carpet Contractor shall notify the General Contractor in writing with copies to the Architect, of any conditions which will prevent him from producing satisfactory finished work. The installation of the carpet shall be an indication of his acceptance of the substrates and he will automatically assume the responsibility for any unacceptable finished work caused by substrate conditions.
- 3.4 INSTALLATION METHODS
- A. FLOOR PREPARATION – The Carpet Contractor shall check floor for moisture content and that the floor is free of dust, oils, grease or other foreign matter. Building must be preheated a minimum of 72 degrees F for at least 24 hours prior to installation with the relative humidity between 35% and 50%. Keep temperature at the same level night and day during installation.
- B. FLOOR CONDITION – Cracks 1/8" or more, holes and unevenness must be filled with a latex base floor filler and the high spots leveled. The Carpet Contractor shall sweep the floor clean using a good bristle broom to keep dust from becoming airborne and wet mop the floor with warm water and sweep again after mopping. Other equal cleaning methods may be used if approved by the Adhesive Manufacturer and the Architect.
- C. ADHESIVES – Carpet shall be securely bonded to the substrate with the waterproof adhesive. The adhesive must be spread using 1/8" wide by 1/8" deep "V" notched trowel. Be sure to maintain trowel notch size throughout the job. Spray applied adhesive is not acceptable. All seams shall be trimmed and fitted in a workmanlike

manner and shall be bonded at the time of installation with seam adhesive, per manufacturer's recommendation. This adhesive must be applied to the cut edge of the carpet at the level of the carpet backing. The carpet must be tightly fitted to all vertical surfaces. All carpet edges that abut on adjacent floor of a different level than the face of the carpet, shall be finished with metal edge molding. Allow installation a minimum of 24 hours to cure before subjecting it to any traffic, moving of furniture, or other heavy equipment.

- 3.5 POST INSTALLATION WORK – Included in this Contract is the provision that the Carpet Contractor shall repair seams, joints, and edges, if required, once after the original installation is completed. The exact time for this work shall be left to the discretion of the Architect, but shall be within twelve (12) months after final approval of the finished installation. Fourteen (14) day notice for this work shall be given by the Architect, so that the Contractor can make necessary arrangements for same. Further, the Contractor shall provide a one (1) year from date of final payment, unconditional guarantee against workmanship covering further repair of seams, puckering, and any other defects that might be directly pointed to defects in workmanship.
- 3.6 MAINTENANCE – The carpet manufacturer shall submit to the Owner four (4) copies of a complete manual of the manufacturer's maintenance recommendations for the carpet. On-site instruction of the Owner's maintenance personnel will be given by the Carpet Contractor.

END OF SECTION 09 6800

DIVISION 09 – FINISHES

SECTION 09 9000 – PAINTING AND COATING

1. GENERAL

1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.

1.2 SCOPE – Furnish all labor, materials, and equipment required to complete all Painting, Staining, Finishing, and Decorating Work as shown on the drawings and as herein specified. The Contractor will be responsible for providing all work that is reasonably required under this SECTION Specification Heading.

The work involved under this SECTION shall include, but not necessarily be limited to, the following:

A. EXTERIOR WORK INCLUDED

1. Hollow metal doors and frames.
2. Grilles, diffusers, and registers in walls.
3. See also paragraph 1.4 for mechanical and electrical painting responsibilities.
4. Elsewhere, as noted on the drawings.

B. INTERIOR WORK INCLUDED

1. Hollow metal doors and frames.
2. Staining and finishing of exposed natural wood.
3. Grilles, diffusers, and registers in walls.
4. Exposed gypsum board.
5. At contact of dis-similar metals or metals to concrete.
6. See also paragraph 1.4 for mechanical and electrical painting responsibilities.
7. Elsewhere, as noted on the drawings.

C. MISCELLANEOUS INCLUDED

1. Color Samples.
2. Product and Color Schedule.

1.3 WORK NOT INCLUDED IN THIS CONTRACT

- A. Uncovered exposed concrete floors.
- B. Decorative exposed non-ferrous metal or metal with prefinished finish.
- C. Items specifically marked "N.I.C." or "BY OWNER" or "Do Not Paint" on plans.
- D. Sanitary wall panels.
- E. Prefinished wood.
- F. Plastic laminate and melamine laminate.
- G. Acoustical ceiling tile and suspension system.
- H. Sealant, except at painted surfaces.

1.4 MECHANICAL AND ELECTRICAL PAINTING

- A. The Painting Subcontractor shall paint all Mechanical Work in the Base Bid and under

Alternates, as follows:

1. Exterior – All Exposed Mechanical and Electrical Work not otherwise finished by the manufacturer or protected with a chrome on brass coating or equal. Galvanized finishes will be painted. Aluminum items will not be painted. Louvers and similar items in walls shall be field painted to match or blend in with adjacent wall surface.
 2. Interior – All Exposed Mechanical and Electrical Work not otherwise finished by the manufacturer such as conduits, pull boxes, panel boards, pipes, access panels, grilles, diffusers, registers, ducts, duct throats, and sprinkler piping, etc. Grilles, diffusers, and registers in walls shall be field painted to match the adjacent wall surface.
- B. In addition to the work listed as not included in Paragraph "1.3" above, the painting or finishing to be done under the Mechanical and Electrical Work is, as follows:
1. All covered or buried Mechanical Work requiring painting will be painted by the Mechanical Subcontractors under whose responsibility such work lies as the work progresses.
 2. Pipe marking or coding.
- 1.5 GUARANTEE – The Contractor and Subcontractor agree to acceptably repair or otherwise correct any deficiencies resulting from his workmanship which develop or become apparent in the work within a period of one (1) year from the date of final acceptance of the work.
- 1.6 PRODUCT AND COLOR SCHEDULE – The Contractor shall submit in triplicate brochures of the Product and Sample Schedule using the colors as selected by the Architect. These schedules shall include information and data of the exact nature of the product the manufacturer is using; the coats of product that will be used; the mil thickness of the coats, the color sample chips and; manufacturer's color number. Submit the schedules to Architect for approval.

2. PRODUCTS

2.1 GENERAL

- A. This specification names Sherwin-Williams products, but does not exclude the use of equivalent performing materials of the other approved manufacturers as listed as follows:
1. Pittsburgh Paints.
 2. Benjamin Moore.
 3. Diamond-Vogel
- B. All materials shall be delivered to the job in their original containers with the labels intact and the seals unbroken.
- C. No paint is to be reduced, adulterated or faster drying induced by addition or drier, unless specifically directed by the paint manufacturer. Thinners or solvents used for clean-up purposes are not to be used in the paint.
- D. Paint shall not have been packaged for over six (6) months unless specifically guaranteed by manufacturers to have longer package stability.

- E. Linseed oil, shellac, and turpentine to be pure, and of highest quality in accordance with the latest ASTM Specification.

2.2 INTERIOR PAINT SYSTEMS

- A. Metal – (Hollow Metal Doors & Frames, Ferrous Metal)
 - 1. Latex Systems (Eggshell / Satin Finish):
 - a. 1st Coat: S-W Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series (5.0 mils wet, 2.0 mils dry).
 - b. 2nd Coat: S-W ProMar 200 Zero VOC Latex Eggshell, B20-2600 Series.
 - c. 3rd Coat: S-W ProMar 200 Zero VOC Latex Eggshell, B20-2600 Series (4.0 mils wet, 1.7 mils dry per coat).
- B. Gypsum Board
 - 1. Latex Systems (Eggshell Finish, Microbicidal):
 - a. 1st Coat: S-W ProMar 200 Zero VOC Interior Latex Primer, B28W2600 (4 mils wet, 1.5 mils dry).
 - b. 2nd Coat: S-W Paint Shield Microbicidal Paint, D12W51 (4 mils wet, 1.8 mils dry per coat).
 - c. 3rd Coat: S-W Paint Shield Microbicidal Paint, D12W51 (4 mils wet, 1.8 mils dry per coat).
- C. Wood - (Casework, Trim):
 - 1. Stain and Varnish System (Satin Finish):
 - a. 1st Coat: S-W WoodClassics 250 Stains.
 - b. 2nd Coat: S-W WoodClassics Waterborne Polyurethane Varnish, A68 Series.
 - c. 3rd Coat: S-W WoodClassics Waterborne Polyurethane Varnish, A68 Series (4 mils wet, 1.0 mil dry per coat).

2.3 EXTERIOR PAINT SYSTEMS

- A. Metal – (Structural Steel, Hollow Metal Doors & Frames, Ferrous Metal)
 - 1. Latex Systems (Semi-Gloss Finish):
 - a. 1st Coat: S-W Pro Industrial Pro-Cryl Universal Primer, B66-1310 Series (5.0-10.0 mils wet, 1.8-3.6 mils dry).
 - b. 2nd Coat: S-W Metalatex Acrylic Semi-Gloss, B42 Series.
 - c. 3rd Coat: S-W Metalatex Acrylic Semi-Gloss, B42 Series (4.0-11.0 mils wet, 1.5-4.0 mils dry per coat).

2.4 MISCELLANEOUS PAINT SYSTEMS

- A. Miscellaneous as/if required:
 - 1. Between Dis-similar Metals
 - a. Shall be an approved heavy bodied bituminous paint having a mixture of asphalt and fibers in conformance with U.S. Federal Specifications SS-C-153 an equal to ALCROMA Black coatings as manufactured by AL-CROMA Co., Stevens, WI.

- 2.5 COLORS – All paint and stain colors will be selected by the Architect, the Subcontractor will prepare triplicate Product and Color Schedules as directed and submit them to Architect for approval.

3. **EXECUTION**

- 3.1 WORKMANSHIP – These specifications are intended to provide for demand the highest quality work and material throughout, in the best trade practice and the standard of "Type 1 Recommended," Painting and Specification prepared and approved by the Painting and Decorating Contractors of America are hereby made a part of this SECTION, and will govern as minimum requirements as they apply except where they are in contradiction with this written specification.
- 3.2 BACK PRIMING – All wood trim and plywood will be back primed with material as specified for the first coat of finish unless otherwise noted.
- 3.3 SURFACE PREPARATION – Special attention is called to the Official Specification of the Painting and Decorating Contractors of America, current edition.
- 3.4 CONTRACTOR SHALL VERIFY, with the manufacturer of metal components (roof deck, structural steel, etc.), the compatibility of the specified paint and the surface receiving the paint. Conduct tests for compatibility, as required.
- 3.5 APPLICATION – Special attention is called to the Official Specification of the Painting and Decorating Contractors of America, current edition, as it applies to this project.
- 3.6 "OLD MASTERS" FINISH – Apply the material before specified as supplied by the manufacturer in accordance with the manufacturer's directions on the label, with a brush. Sand each coat with #00 sandpaper and buff final coat with a fine steel wool.
- 3.7 PROTECTION – Protect all surfaces adjacent to work with drop cloths, masking, etc. Keep hardware that cannot be removed, completely free of paint or stains. Remove all paint from glass, hardware, floors, prefinished millwork, and finished metal.
- 3.8 EPOXY PAINT WORK
- A. SURFACE PREPARATION – All designated surfaces are to be prepared in a workmanlike manner with the object of obtaining a surface that is clean, dry, free of foreign matter and conforming to the degree of surface preparation required. Surface preparation, priming and coating application shall be approved by the Architect before the next application proceeds. Surfaces are to be prepared in accordance with the manufacturer's best current recommendations.
- B. GENERAL
1. Interior surfaces should not be coated when the surface temperature is below 60 degrees F.
 2. Cleaning and painting shall be scheduled so that dust and other contaminants from the blasting or cleaning process will not fall on wet, newly painted surfaces.
 3. All equipment shall be maintained in good working order. It must be thoroughly cleaned and inspected daily. Worn spray nozzles, tips, etc., shall be replaced on a regular basis.
 4. Effective operating oil and water separators shall be used and serviced daily on all air lines. Place them as close as possible to the work site and maintain a continuous small bleed.
- 3.9 COMPLETION – Finish work shall be free from all dust, debris, or damage resulting from any activity under the Painting Subcontractor. Provide or correct any defects resulting

from the painting activity. Damages resulting from painting activity shall be repaired by Painting Subcontractor at his expense. On completion, the Painting Subcontractor shall remove from the building all material and debris created by him and leave his part of the work in a clean and finished condition, acceptable to the Owner's Representative.

END OF SECTION 09 9000

DIVISION 10 – SPECIALTIES

SECTION 10 2113 – TOILET COMPARTMENTS

1. GENERAL

- 1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.
- 1.2 SCOPE – Furnish all labor, materials and equipment required to complete all Toilet Compartment Work as shown on the drawings and as herein specified. The Contractor will be responsible for providing all work that is reasonably required under this SECTION Specification Heading.

Work involved under this SECTION shall include, but not necessarily be limited, to the following items:

- A. High Density Polyethylene Toilet Partitions.
- B. Submittals.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Toilet Accessories – SECTION 10 2800 – TOILET, BATH, AND LAUNDRY ACCESSORIES.

- 1.4 SUBMITTALS – Submit shop drawings on all toilet compartments showing all details of construction and coordination with other items of work, in accordance with SECTION 01 3300 – SUBMITTAL REQUIREMENTS.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum five (5) years experience in manufacture of solid plastic toilet compartments with products in satisfactory use under similar service conditions.
- B. Installer Qualifications: Minimum five (5) years experience in work of this Section.

- 1.6 WARRANTY – Manufacturer shall supply a written warranty covering all components and plastic hardware against breakage, corrosion, and delamination for a period of twenty-five (25) years.

2. PRODUCTS

- 2.1 MANUFACTURERS – Toilet partitions and restroom countertops shall be as manufactured by Scranton Products, Partition Systems International of South Carolina, General Partitions Corp., or approved equal.
- 2.2 MATERIALS – Panels, doors, and pilasters shall be fabricated from High Density Polyethylene (HDPE) resins containing a minimum of 25% recycled material manufactured under high pressure, forming a single component section which is

waterproof, non-absorbent, and has a self-lubricating surface that resists marking with pens, pencils, or other writing utensils. All components to arrive at job-site with special protective plastic covering.

2.3 CHARACTERISTICS

- A. Panels and pilasters shall be 1" thick with all edges rounded to a ¼" radius.
- B. Dividing panels shall be 55" high and mounted at 14" above the finished floor.
- C. Pilasters shall be 82" high and fastened into a one-piece 3" high pilaster shoe with a stainless steel, tamper resistant torx head sex bolt.

2.4 HARDWARE

- A. Door Hardware
 - 1. Hinges shall be integral hinge system. Pilaster to be machined to accept door and hinge mechanism. Hinge mechanism consists of a 2 piece ½" diameter nylon pin with "Cam Action" and a 3/16" stainless steel pin inserted into lower portion of pilaster and door. A one-piece ½" diameter, 4" long nylon pin to be inserted into the top portion of the pilaster and door. Door closures to be factory set to accommodate all conditions and allow for a positive opening and closing action free of impediment.
 - 2. Each door to include (1) coat bumper/hook. Each outswing door to include (1) pull and (1) wall stop.
 - 3. Door strike and keeper shall be fabricated from heavy aluminum extrusion (6364-T5 Alloy) with clear anodized finish, with wrap-around flange surface mounted and thru-bolted to pilaster with one-way sex bolts. Size of strike shall be 6" in length.
 - 4. Door latch housing shall be fabricated from heavy aluminum extrusion (6364-T5 Alloy) with clear anodized finish, surface mounted and thru-bolted to door with one-way sex bolts. Slide bolt and button shall be heavy aluminum with black anodized finish.
- B. Pilaster shoes shall be anchored to finished floor with plastic anchors and #14 x 1 ½" stainless steel tamper resistant torx screws.
- C. Wall brackets shall be 54" long extruded plastic with a wall thickness of 3/16". Wall brackets will be fastened to the pilaster with stainless steel, tamper resistant torx screws and fastened to the panels with stainless steel, tamper resistant torx head sex bolts.
- D. Headrail shall be heavy aluminum extrusion (6364-T5 Alloy) with bright-dipped anodized finish in anti-grip configuration. Headrail shall be fastened to tops of pilasters and headrail brackets with stainless steel, tamper resistant torx head sex bolts.
- E. Headrail brackets shall be 16 ga. stainless steel and secured to the wall with #14 stainless steel screws.

3. EXECUTION

3.1 PREPARATION

- A. Examine areas to receive toilet partitions, screens, etc. for correct height and spacing of

anchorage/blocking and plumbing fixtures that may affect installation of partitions.
Report any discrepancies to the Architect.

B. Take complete and accurate measurements of complete toilet compartment locations.

3.2 FABRICATION – Work shall be smooth, unblemished, and free from defections, impairing strength, durability and appearance. All work shall be fabricated in accordance with the best practice of the trade, the manufacturer's standard details and complete in every respect. The manufacturer shall check the shop drawing before submission to the Owner's Representative.

3.3 INSTALLATION – Shall be first-class by experienced competent mechanics strictly in accordance with the best practice of the trade and manufacturer's recommendations. Protect all work until building is ready for occupancy.

END OF SECTION 10 2113

DIVISION 10 – SPECIALTIES

SECTION 10 2623 – PROTECTIVE WALL COVERING

1. GENERAL

1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.

1.2 SCOPE – Furnish all labor, materials and equipment required to complete all Protective Wall Covering Work as shown on the drawings and as herein specified. The Contractor will be responsible for providing all work that is reasonably required under this SECTION Specification Heading.

Work involved under this SECTION shall include, but not necessarily be limited, to the following items:

- A. Protective Wall Coverings.
- B. Submittals.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Gypsum Board – SECTION 09 2116 – GYPSUM BOARD ASSEMBLIES.

1.4 SUBMITTALS – Submit samples and shop drawings on all protective wall coverings showing all locations, extent, and installation details and coordination with other items of work, in accordance with SECTION 01 3300 – SUBMITTAL REQUIREMENTS.

1.5 QUALITY REQUIREMENTS

- A. Fire performance characteristics: Provide wall protection system components with UL label indicating that they are identical to those tested in accordance with ASTM E84 (CAN/ULC-S102.2) for Class 1 characteristics listed below:
 - 1. Flame spread: 25 or less
 - 2. Smoke developed: 450 or less

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials in original undamaged packages and containers inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
 - 1. Maintain room temperature within the storage area between 60° F and 80° F during the period plastic materials are stored. Keep materials out of direct sunlight to avoid excessive surface temperatures.
 - 2. Store in a horizontal position for a minimum of 72 hours, or until the plastic material attains the ambient room installation temperature of between 65° F and 75° F.

1.7 PROJECT CONDITIONS

- A. Maintain constant air temperature within building at 65°F for a minimum of 48 hours prior to beginning of installation.

- B. Maintain wall temperature between 65°F and 85°F during installation.
- C. Do not install wall surface protection system components until the space is enclosed, weather proof and climate controlled.
- D. Do not install wall protection systems until temperature is stable and relative humidity is less than 80%.

2. PRODUCTS

2.1 MATERIALS

- A. PROTECTIVE WALL COVERING – Shall be Palladium by Inpro, or approved equal.
 - 1. Fire Rating – Class A.
 - 2. Thickness – 0.040", 0.060"
 - 3. Color – Standard color as selected by Architect.
 - 4. Texture – Standard texture as selected by Architect.
- B. ADHESIVES – Shall be as recommended by wall covering manufacturer.
- C. ACCESSORIES – Moldings, sealant, and any other accessories for a complete system shall be furnished by wall covering manufacturer.

3. EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions in which wall surface protection components and wall protection systems will be installed.
- B. Complete finishing operations, including painting, before beginning installation of wall surface protection system materials.
- C. Wall surfaces to receive impact-resistant wall covering materials shall be dry and free from dirt, grease, loose paint, and scale.
- D. Do not proceed with installations until unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Prepare walls in accordance with manufacturer's written instructions.
- B. Remove dust, dirt, grease, oil, loose paint, and scale.
- C. Resurface uneven wall surfaces and damaged walls.
- D. Seal wall with white prime seal.

3.3 INSTALLATION

- A. Install the work of this section in strict accordance with the manufacturer's recommendations, using only approved materials.
- B. Allow wall covering and adhesive to precondition for a minimum of 24 hours at a temperature between 65°F and 85°F before installation.
- C. Install sheets with texture running in the same direction for uniform appearance.

- 3.4 CLEANING – Immediately upon completion of installation, clean in accordance with manufacturer's recommended cleaning method. Remove excess adhesive and layout marks.

- 3.5 PROTECTION – Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.

END OF SECTION 10 2623

DIVISION 10 – SPECIALTIES

SECTION 10 2800 – TOILET, BATH, AND LAUNDRY ACCESSORIES

1. GENERAL

- 1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.
- 1.2 SCOPE – Furnish all labor, materials and equipment required to complete all Toilet, Bath, and Laundry Accessories Work as shown on the drawings and as herein specified. The Contractor will be responsible for providing all work that is reasonably required under this SECTION Specification Heading.

Work involved under this SECTION shall include, but not necessarily be limited, to the following items:

- A. Grab Bars.
- B. Toilet Paper Dispensers.
- C. Diaper Changing Stations (Drop-in type).
- D. Framed Mirrors.
- E. Submittals.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Toilet Partitions – SECTION 10 2113 – TOILET COMPARTMENTS.

- 1.4 SUBMITTALS – Submit shop drawings on all toilet, bath, and laundry accessories showing all details of construction and coordination with other items of work, in accordance with SECTION 01 3300 – SUBMITTAL REQUIREMENTS.

2. PRODUCTS

- 2.1 GRAB BARS – Shall be Bobrick No. B-5806, American Specialties, No. 3700; or approved equal, .99 stainless steel grab bars 1 ¼" diameter bars, satin finish, and concealed mounting as shown on the drawings. One (1) 42" long and one (1) 36" long grab bar will be required in each accessible stall.

2.2 TOILET PAPER DISPENSERS

- A. Surface Mounted Double-Roll – Shall be Bobrick No. B-76867, American Specialties No. 7305-2S, or approved equal, satin finish.

- 2.3 FRAMED MIRRORS – Shall be Bobrick No. B-165, American Specialties No. 620, or approved equal. See drawings for required sizes.

- 2.4 DIAPER CHANGING STATION (Countertop Drop-in Type) – Shall be Koala Kare KB112-01CT, or approved equal.

3. EXECUTION

- 3.1 FABRICATION – Work shall be smooth, unblemished and free from defections, impairing strength, durability and appearance. All work shall be fabricated in accordance with the best practice of the trade, the manufacturer's standard details and complete in every respect. The manufacturer shall check the shop drawing before submission to the Owner's Representative.
- 3.2 INSTALLATION – Shall be first-class by experienced competent mechanics strictly in accordance with the best practice of the trade and manufacturer's recommendations. Protect all work until building is ready for occupancy.

END OF SECTION 10 2800

DIVISION 10 – SPECIALTIES

SECTION 10 4400 – FIRE PROTECTION SPECIALTIES

1. GENERAL

- 1.1 RELATED DOCUMENTS – DRAWINGS AND PROVISIONS OF DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS AND DIVISION 01 – GENERAL REQUIREMENTS apply to work of this SECTION.
- 1.2 SCOPE – Furnish all labor, materials, equipment and accessories to complete all Fire Protection Specialties as shown on the drawings, and as herein specified. The Contractor will be responsible for providing all work that is reasonably required under this SECTION Specification Heading.

Work involved under this SECTION shall include, but not necessarily be limited to, the following items:

- A. Fire Extinguishers.
 - B. Fire Extinguisher Cabinets.
 - C. Submittals.
- 1.3 SUBMITTALS – The fabricator shall prepare and submit for approval, detailed Shop Drawings for all fabricated items and receive approval before starting fabrication. Submission shall be in accordance with SECTION 01 3300 – SUBMITTAL REQUIREMENTS.

2. PRODUCTS

- 2.1 FIRE EXTINGUISHER (FE) – Shall be dry chemical by Amerex, or approved equal; with the minimum following ratings:
- FEC-1 (cabinet): 2A10BC
- 2.2 FIRE EXTINGUISHER CABINETS (FEC) – Shall be Modern Metal Products, No. 1025SR2 (Semi-Recessed), F-Full Glass Door (Tempered), J.L. Industries, Larsen's, or approved equal. Semi-recessed steel cabinet and painted steel door with tempered glass vision panel, 24" H x 9 ½" x 5" D (inside dimension).

END OF SECTION 10 4400

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SECTION 22 0500 – PLUMBING COMMON WORK RESULTS

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the equipment and systems indicated by the Contract Documents with supplementary items necessary for proper installation.

1.2 REFERENCES

- A. Plumbing work shall comply with specification section 230500.
- B. In addition to Division 22, Plumbing work shall comply with the following sections:
 - 1. Section 230500 HVAC Common Work Results
 - 2. Section 230529 Pipe Hangers and Supports
 - 3. Section 230553 Mechanical Identification
 - 4. Section 230593 Cleaning and Testing
 - 5. Section 230594 Testing Adjusting and Balancing
 - 6. Section 230719 Piping Insulation

1.3 SUBMITTALS

- A. Submittals must be reviewed and approved by the Contractor before submitting them to the Engineer.

1.4 REGULATORY AND UTILITY REQUIREMENTS

- A. Contractor is responsible for coordinating all required site inspections by authorities having jurisdiction. Contractor shall notify General Contractor of all scheduled inspections seven (7) working days prior to site visit.
- B. Contractor is responsible for paying for all fees, permits, and inspections required to complete their work.
- C. Contractor shall include all work required to install new and relocate utilities and meters as shown on drawings.
- D. Utility work 5'-0" from outside of building is by others, unless shown otherwise.
- E. Contractor shall notify Owner of any utility service shutdown 48 hours in advance. This includes water, sanitary, and storm systems.

1.5 SUBSTITUTIONS

- A. All manufacturers listed as Acceptable Manufacturers in each specification section are considered equal to the basis of design. The basis of design is preferred and will take precedence. Any products from an alternate approved manufacturer need to meet the requirements and performance specified and shall be equal to the basis of design.
- B. The Contractor may request permission for a substitution of any item (equipment or material), subject to the following conditions:
 - 1. Submit substitution requests in writing to the Engineer, on a form supplied by the Engineer. A sample copy of this form is included at the end of this section. An electronic copy can also be provided to the Contractor by the Engineer.
 - 2. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contractor documents, the Contractor is responsible for all costs involved in integrating the equipment or accessories into the system and the assigned space and for obtaining the performance from the system into which these items are placed as well as any re-design costs incurred by the Architect or Engineer. The Contractor is also responsible for coordinating changes required by other trades.
 - 3. Any requests for alternate manufacturers must be submitted to the Architect/Engineer at least ten (10) days prior to bid day. Incomplete substitution requests will not be considered.
- C. Approval
 - 1. No work involving requests for substitution shall commence without written approval on the provided form by the Engineer.
 - 2. Any work started or material ordered/installed by the Contractor without written approval shall be removed/repared at the sole expense of the Contractor. The Contractor will also be responsible for any costs incurred by the Owner for such rework.

1.6 COORDINATION DRAWINGS

- A. The mechanical contractor shall be responsible for producing coordination drawings. The drawings will need to incorporate piping, ductwork, equipment, lighting, conduits, building structure and all other building and system components that will need to be coordinated for proper systems installation and operation.
- B. The plumbing contractor shall provide all necessary information to the mechanical contractor to produce coordination drawings. The contractor shall also attend and participate in all coordination meetings.
- C. The drawings will be 1/4" scale.
- D. Coordination meetings will be conducted on site with all concerned contractors present. Representatives from the Owner, Architect and Engineer will also be present to review conflicts and approve contractor variations to the contract documents.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 CONCRETE BASES

- A. Refer to specification section 230500 HVAC Common Work Results and individual equipment specifications for additional requirements.

END OF SECTION

SECTION 22 0523 – PLUMBING VALVES

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the following Plumbing Valves indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Equipment Included in This Section
 - 1. All valves shown on the plumbing drawings.
 - 2. Valves to isolate all plumbing fixture groups.
 - 3. Valves to isolate water heaters and other plumbing equipment.
 - 4. Valves to isolate owner provided equipment.

1.2 REFERENCES

- A. Abbreviations
 - 1. IBBM: Iron body, bronze mounted.
 - 2. OS&Y: Outside screw and yoke.
 - 3. WOG: Water, oil, gas.
 - 4. WSP: Working steam pressure.

1.3 SUBMITTALS

- A. Product Data: Catalog sheets, specifications and installation instructions for each valve type.
- B. Operation and Maintenance Data: For valves, safety valves, pressure-reducing valves, air vents, vacuum breakers, and meters to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements
 - 1. Comply with the most recent version following standards:
 - a. Safe Drinking Water Act (SDWA) and the associated lead content requirements.

PART 2 - PRODUCTS

2.1 VALVES - GENERAL

- A. Acceptable Manufacturers (unless specified otherwise)
 - 1. Apollo
 - 2. Conbraco
 - 3. Crane
 - 4. Hammond
 - 5. Milwaukee
 - 6. Nibco
 - 7. Stockham
 - 8. Victaulic
 - 9. Watts
 - 10. HCI Terminator
- B. Valve Standardization: Valves from one or more manufacturers may be used, however valves supplied for each specific valve type shall be the product of one manufacturer.
- C. Valves shall be first quality, free from all imperfections and defects, with body markings indicating manufacturer and rating.
- D. Valve parts of same manufacturer, size and type shall be interchangeable.
- E. Valves which use packing shall be capable of being packed when wide open and under full working pressure.
- F. Size valves the same size as the piping in which they are installed, unless specified otherwise.
- G. Provide extended shafts for all valves installed on insulated piping.
- H. Coordinate the end connection type with the piping and other specialties in the systems. Refer to the piping usage schedule for additional requirement. The following are acceptable styles:
 - 1. Solder
 - 2. Mechanical press
 - 3. Threaded
 - 4. Flanged
 - 5. Grooved

- I. Provide unions in the system as needed for installation or removal of valves and specialties.
- J. Manually operated gate, globe and angle valves shall be of rising stem type, unless otherwise specified.

2.2 CHECK VALVES

- A. CK-1: 125 psig WSP; 200 psig WOG; bronze body; brass, bronze, or 304 stainless steel trim; Y-pattern; horizontal swing; renewable/regrindable bronze seat disc.
- B. CK-2: 125 psig WSP; 200 psig WOG; bronze body; brass, bronze, or 304 stainless steel trim; Y-pattern; horizontal swing; renewable/regrindable PTFE seat disc.

2.3 BALL VALVES

- A. BV-1: 150 psig WSP, 600 psig WOG, two (2) piece bronze body, full-port, solid blow-out proof 316 stainless steel stem, PTFE seats, 316 stainless steel ball, PTFE seals, corrosion resistant steel lever handles with vinyl grips, and balancing stop.

2.4 BALANCING VALVES

- A. Automatic Type
 - 1. Acceptable Manufacturers:
 - a. Circuit Solver
 - 2. Valve shall regulate the flow of recirculated domestic hot water based on water temperature entering the valve regardless of system operating pressure. As the water temperature increases the valve proportionally closes dynamically adjusting flow to meet the specified temperature. The valve shall never fully close, even at the desired set point. There is always sufficient bypass flow back to the recirculating pump to prevent overheating or "dead heading" of the pump.
 - 3. The valve shall be set at the factory for the desired return temperature. No field adjustments are required. The following factory temperature set points are available.
 - a. 100°F / 105°F / 110 °F / 115°F / 120°F / 125°F / 130°F / 140°F
 - 4. The hot water system temperatures shall have the corresponding hot water recirculation temperatures:
 - a. 120°F hot water temp / 105°F hot water circ temp
 - 5. The valve shall stay fully open at approximately 10°F below closing temperature.
 - 6. The assembly shall be available in ½", ¾" and 1"
 - 7. Valve body and all internal components are made with lead free materials with major components constructed of type 303 stainless steel.
 - a. Valve rated to 200 PSIG maximum working pressure and 250°F maximum working temperature.

8. Thermal actuator shall be spring loaded and self cleaning, delivering closing thrust sufficient to keep orifice opening free of scale deposits.
9. Install valve in each domestic hot water return piping branch beyond last hot water device in that branch.
10. Balancing valves to be provided with the following accessories as indicated on the drawings:
 - a. Check valve
 - b. Strainer (20 mesh)
 - c. Thermometer
 - d. Ball valve (assembly inlet and outlet)
11. Coordinate flow arrow, especially with valves that have an integrated check valve

2.5 SAFETY AND RELIEF VALVES

- A. General Requirements: Valves shall be as specified by ASME Code governing manufacture of such valves within scope of their particular usage, i.e., Heating Boilers, Unfired Pressure Valves, etc., shall be tested, rated and listed, unless otherwise specified. Valves for applications specified shall conform to the ASME Code, Section IV, Heating Boilers and the following:
 1. Valves for combination domestic hot water heater and storage tanks shall conform to the requirements of ASME Code, Section IV and USA Standard Z21.22 and shall be NBB listed. Valves shall be of the temperature - pressure type. Thermostatic element shall, on rising temperature, cause the valve to open at 200° F and valve shall deliver its rated capacity at 210° F and close drip tight at 195° F. Valves shall be sized in accordance with Unfired Vessel Code.
 2. End Connections: Unless otherwise specified, safety valves, relief valves and safety relief valves, in sizes 3/4 inch to 3 inches IPS inclusive, may be furnished with male or female pipe thread inlet and female pipe thread outlet; valves over 3 inches IPS must be furnished with 125 lb. or 250 lb. inlet and may be equipped with 125 lb. outlet.

2.6 GAUGE COCKS

- A. Acceptable Manufacturers:
 1. Marsh Instrument Company
 2. Mueller Instruments Co.
 3. H.O. Trerice Co.
 4. Weksler Instruments Corp.
- B. Gauge Cocks: All brass construction, "T" or lever handles, built for 300 psig hydraulic pressure.

2.7 STRAINERS

- A. Acceptable Manufacturers:
 1. Zurn

2. Watts

- B. All strainers to be constructed of lead free brass, bronze, or copper and shall be rated for use in potable water systems and shall meet the requirements of NSF/ANSI 372. Strainers shall include 20 mesh stainless steel strainer screen and tapped access cover and pipe plug.

2.8 HEAT TRAP FITTING

A. Acceptable Manufacturers

1. Rheem/Ruud
2. Prior approved equal

- B. Dielectric nipple-style heat trap to prevent heat loss through top water heater storage tank connections. Plastic ball flow control with inert thermoplastic lining for anti-corrosion. Heat trap fitting shall be factory-marked (color coded or flow direction stamped) for hot and cold installations. Ball seat to allow for thermal expansion bypass.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install valves at locations noted on the drawings and as specified below:

1. Install isolation valves at branch takeoffs from mains.
2. Install a common isolation valves for branch lines to each group of fixtures.
3. Install isolation valves above ceiling (in an accessible location) for each fixture if fixture is not provided with integral stops.

3.2 VALVE APPLICATION SCHEDULE

A. Schedule of valve applications for the different services is as follows:

1. Cold Water, Domestic Hot Water and Circulating (CW, HW, HWC) located inside building, 125 psig and Less:
 - a. 3 inch and Less: BV-1, CK-1, CK-2.

END OF SECTION

SECTION 22 1100 - PLUMBING PIPING

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the following Plumbing Piping Systems indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Equipment Included in this section:
 - 1. Cold Water
 - 2. Hot Water
 - 3. Hot Water Recirculation
 - 4. Sanitary
 - 5. Vent
 - 6. Water Service

1.2 REFERENCES

- A. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. The adopted version of the **Uniform** Plumbing Code shall be applicable to this Project unless identified by a specific edition date.

1.3 SUBMITTALS

- A. Product Data
 - 1. Catalog sheets and specifications indicating manufacturer name, pipe/fitting type, applicable reference standard, schedule, or class for specified pipe and fittings.
 - 2. Material Schedule: Itemized pipe and fitting material list for each specified piping application in Pipe and Fittings Schedule as defined in Part 3 of this specification section. Where optional materials are specified indicate option selected.
- B. Submit piping layout drawings as per specification section 230500 HVAC Common Work Results.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements
 - 1. Comply with the most recent version following standards:

- a. Safe Drinking Water Act (SDWA) and the associated lead content requirements.
 2. Use only materials and methods allowed by applicable codes and authority having jurisdiction (AHJ). It is the contractor's responsibility to confirm if plastic piping is acceptable with the AHJ prior to installation.
- B. Qualification of Brazers
1. Comply with the following: The persons performing the brazing and their supervisors shall be personally experienced in brazing procedures.

1.5 EXTRA MATERIALS

- A. Provide new manual pipe cutting and crimp ring tools for PEX piping. Crimping tool shall be capable of crimping joints for all sizes of piping installed on job. Tools shall be same as pipe manufacturer. Tools shall include instructions.

PART 2 - PRODUCTS

2.1 STEEL PIPE AND FITTINGS

- A. Steel Pipe for Threading: Standard weight, Schedule 40, black; ASTM A 53 or ASTM A 135.
- B. Steel Pipe for Roll Grooving: Standard weight, Schedule 40, black; ASTM A 53, Grade B, Type F for sizes 3/4" to 1-1/2", and Type E or S for sizes 2" to 24", or ASTM A 135.
- C. Malleable Iron, Steam Pattern Threaded Fittings
1. 150 lb Class: ASME B16.3.
 2. 300 lb Class: ASME B16.3.
- D. Cast Iron Fittings
1. Drainage Pattern, Threaded: ASME B16.12.
 2. Steam Pattern, Threaded: ASME B16.4.
 - a. Standard Weight: Class 125.
 - b. Extra Heavy Weight: Class 250.
 3. Flanged Fittings and Threaded Flanges: ASME B16.1.
 - a. Standard Weight: Class 125.
 - b. Extra Heavy: Class 250.
- E. Unions: Malleable iron, 250 lb class, brass to iron or brass to brass seats.
- F. Couplings: Same material and pressure rating as adjoining pipe, conforming to standards for fittings in such pipe. Use taper tapped threaded type in screwed pipe systems operating in excess of 15 psig.

- G. Nipples: Same material and strength as adjoining pipe, except nipples having a length of less than one inch between threads shall be extra heavy.

2.2 COPPER AND BRASS PIPE, TUBING AND FITTINGS

- A. Copper Tube, Types K and L: ASTM B 88.
- B. Wrought Copper Tube Fittings, Solder Joint: ASME B16.22.
- C. Cast Copper Alloy Tube Fittings, Solder Joint: ASME B16.18.
- D. Drainage Tube, Type DWV: ASTM B 306.
- E. Wrought Copper Drainage Tube Fittings, Solder Joint: ASME B16.29.
- F. Cast Copper Alloy Drainage Fittings, Solder Joint: ASME B16.23.
- G. Chrome Plated Grade A Red Brass Threaded Pipe, Standard Weight: ASTM B 43.
 - 1. Plating: 0.02 mil chromium over 0.2 mil nickel plating, high polish finish. Unions: Cast bronze, 150 lb Class, bronze to bronze seats, threaded or solder joint.
- I. Flared Tube Fittings
 - 1. Water Tube Type: ASME B16.26.
- J. Flanges: Conform to the Standards for fittings used in systems.
 - 1. Brazing Flanges: ASME B16.24, hubs modified for brazing ends.
- K. Mechanical Press Fittings
 - 1. Copper with EPDM seals; ASME B16.51, NSF-61.

2.3 CAST IRON PIPE AND FITTINGS

- A. Bell and Spigot Soil Pipe: Service Weight, Bitumin coated; ASTM A 74, CISPI/NSF. All pipes shall be marked with CISPI and NSF listing.
- B. Bell and Spigot Soil Pipe Fittings: Service Weight, Bitumin coated; ASTM A 74, CISPI/NSF.
- C. Bell and Spigot Soil Pipe Gaskets: ASTM C564
- D. Hubless Pipe: Bitumin coated; CISPI Standard No. 301. All pipes shall be marked with CISPI and NSF listing.
- E. Hubless Pipe Fittings: Drainage Pattern, Bitumin coated; CISPI No. 301.
- F. Hubless Joint Couplings: Stainless steel shield and clamp assembly, and elastomer sealing sleeve; CISPI-310.

2.4 DUCTILE IRON PIPE AND FITTINGS

- A. Water Pipe: Bitumin coated and cement-mortar lined; AWWA C151.
 - 1. 3" - 4": Class 51.
 - 2. 6" and Over: Class 50.
- B. Fittings: Bitumin coated and cement-mortar lined; AWWA C110.

2.5 COUPLINGS AND FITTINGS FOR GROOVED END PIPE

- A. Couplings: Gruvlok Fig. 7401 or 74, or Victaulic Co.'s Style 07 or 107, having minimum pressure rating of:
 - 1. 750 psi from 1-1/2" to 4"
 - 2. 700 psi for 6"
 - 3. 600 psi for 8"
- B. Couplings: Gruvlok Fig. 7001, or Victaulic Co.'s Style 77, having pressure rating of:
 - 1. 1000 psi for 3/4" to 6"
 - 2. 800 psi for 8" to 12"
 - 3. 300 psi for 14" to 24"
- C. Fittings: By same manufacturer as couplings, having pressure ratings equal to or greater than couplings. Comply with the following standards:
 - 1. Steel: ASTM A 53 or A 106, Grade B.
 - 2. Malleable Iron: ASTM A 47.
 - 3. Ductile Iron: ASTM A 536.

2.6 PEX PIPING AND FITTINGS

- A. Acceptable Manufacturers:
 - 1. Uponor
 - 2. Rehau
- B. Pipe: Pex-a (Engel Method Crosslinked Polyethylene Piping) for potable water use. Meets ASTM Standards F-876, F-877 and E84, NSF Standards 14, 61 & 372, PEX 5306.
 - 1. Color: Piping may be white, red, or blue in color. If red/blue colored piping is used, red must be used for all hot water pipe and blue for cold water. Maintain color scheme throughout building.

2. Note: If using color coded tubing as described above, then labeling of these pipes may be omitted.
- C. Fittings: All fittings used with crosslinked polyethylene (PEXa) water distribution pipe shall be cold-expansion fittings with PEXa reinforcing ring. Meets ASTM Standard F1960. Fittings same as pipe manufacturer. All fittings shall be completely brass or polymer. Use copper stub-outs for fixture rough-ins, PEX shall not be exposed out of the wall at fixture rough-ins.
1. Brass fittings to be lead-free ECO Brass UNS C69300
 2. Polymer fittings in accordance to ASTM D 6394
- D. Valves: Lead-free brass ball valve.
1. Manufacturer: valve from same manufacturer as piping system.
 2. Ball valve: full-port, two-piece, positive stop shoulder, ASTM F1960 cold-expansion ends with PEXa reinforcing ring.
- E. Accessories: Stub-out plates shall be used to support rough-in piping for fixture connections.

2.7 PVC PIPING AND FITTINGS

- A. Pipe: Schedule 40 PVC , Type I, rated for 140° F, ASTM D2665
- B. Fittings: Same as pipe manufacturer; ASTM D2466. Solvent welded using solvent approved by manufacturer.

2.8 CPVC ACID WASTE/VENT PIPE AND FITTINGS

- A. Pipe: Schedule 40 CPVC, Type IV Grade I rated for 220° F at no pressure, ASTM D 2618, NSF. Minimum cell classification of 23447. All pipe, fittings and cement shall be supplied as a system by a single manufacturer and shall be certified by NSF International for use in corrosive waste drainage systems and shall bear the mark "NSF-cw".
- B. Fittings: Same as pipe manufacturer, complying with ASTM F438 socket types. Solvent welded using manufacturer provided solvent rated for laboratory chemical use, ASTM F493. Includes all piping starting at the fixture served until the piping leaves the building or discharges to an acid neutralization tank.
- C. Fire Spread/Smoke Developed Rating of 25/50 or less based on ASTM E 84.
- D. Buried pipe shall be installed in accordance with ASTM D 2321 and ASTM F 1668.

2.9 JOINING AND SEALANT MATERIALS

- A. Thread Sealant
1. LA-CO Industries', Slic-Tite Paste with Teflon.
 2. Loctite Corp.'s No. 565 Thread Sealant.
 3. Thread sealants for potable water shall be NSF approved.

- B. Solder: Solid wire type conforming to the following:
 - 1. Lead-free tin-silver solder (ASTM B 32 Alloy Grade E, AC, or HB)
- C. Brazing Alloys
 - 1. Type 1: AWS A5.8, Class BCuP-5, for brazing copper to brass, bronze, or copper.
 - 2. Type 2: AWS A5.8, Class BAg-7, for brazing copper to steel or stainless steel.
- D. Brazing Flux: FS O-F-499, Type B.
- E. Gaskets For Use With Ductile Iron Water Pipe and Cast Iron Drainage Pipe: Synthetic rubber rings (molded or tubular): Clow Corp.'s Belltite, Tyler Pipe Industries Inc.'s Ty-Seal, or U.S. Pipe and Foundry Co.'s Tyton.
- F. Flange Gasket Material
 - 1. For Use With Cold Water: 1/16" thick rubber.
 - 2. For Use With Hot Water, Air or Steam: Waterproofed non-asbestos ceramic or mineral fiber, or a combination of metal and water-proofed non-asbestos ceramic or mineral fiber, designed for the temperatures and pressures of the piping systems in which installed.
- G. Gaskets For Use With Grooved End Pipe and Fittings: Type and materials as recommended and furnished by the fitting manufacturer, for the service of piping system in which installed.
- H. Anti-Seize Lubricant: Bostik Inc.'s Never Seez or Dow Corning Corp.'s Molykote 1000.

2.10 PACKING MATERIALS FOR BUILDING CONSTRUCTION PENETRATIONS

- A. Oiled Oakum: Manufactured by Nupak of New Orleans, Inc.
- B. Mechanical Modular Seals: Thunderline Corp.'s Link Seal wall and floor seals designed for the service of piping system in which installed.

2.11 DIELECTRIC CONNECTORS

- A. Use for all connections between piping connections of dissimilar materials.
- B. Unions
 - 1. Rated 250 psig at 180° F; ASME B16.39; Wilkins Model DU.
 - 2. Rated 100 psig at 210° F; ASME B16.39; Wilkins Model DU with high temperature gasket.
 - 3. Rated Above 100 psig and 210° F: Use Flange Electrical Insulation Kit specified below.
- C. Flange Electrical Insulation Kit: Consisting of dielectric sleeves and washers, and dielectric gasket.
 - 1. Rated 150 psi at 250° F: ANSI Class 150, full faced neoprene gasket with bolt holes, double phenolic washers, and Mylar sleeves; Model 150 by APS, Lafayette, LA.

2.12 PIPE SLEEVES

- A. Install pipe sleeves as noted on the drawings or indicated in this specification section. The following piping material shall be used as noted in the installation section in this specification:
 - 1. Type A: Schedule 40 steel pipe.
 - 2. Type B: No. 16 gauge galvanized sheet steel.
 - 3. Type C: Schedule 40 steel pipe with 1/4" steel collar continuously welded to pipe sleeve. Size steel collars as required to span a minimum of one (1) cell or corrugation, on all sides of the rough opening thru the metal deck.
 - 4. Type D: No. 16 gauge galvanized sheet steel with 16 gauge sheet steel metal collar rigidly secured to sleeve. Size metal collars as required to span a minimum of one (1) cell or corrugation, on all sides of the rough opening thru the metal deck.

2.13 PIPING ESCUTCHEONS

- A. Cast Brass: Polished chrome plated finish, with set screw.
- B. Cast Iron: Solid type, unplated, with set screw; Model 395 by Grinnell Corp.

2.14 THERMOMETERS

- A. Acceptable Manufacturers
 - 1. Weiss Instruments
 - 2. Prior Approval
- B. Bi-Metal Thermometers
 - 1. Body: Type 304 Stainless Steel, heavy glass face, and hermetically sealed.
 - 2. Bimetallic Element: Bimetallic element calibrated to meet temperature standards of manufacturer and helix assembly with silicon dampening.
 - 3. Stem: Stainless steel to match body and of a length to suit installation. Bare stem shall be used for hydronic systems in non-corrosive applications.
 - 4. Connector: 3/4 inch, with ASME B1.1 screw threads.
 - 5. Accuracy: Plus or minus 1 percent of scale range or one scale division, to maximum of 1.5 percent of scale range.
 - 6. See piping application schedule for thermometer range requirements based on system type.
- C. Liquid in Glass Thermometers
 - 1. Body: Molded plastic with variable angle mounting compliant with ASME B40.200.

2. Tube: Glass with magnifying lens, blue organic liquid, nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
 3. Stem: Aluminum or brass and of a length to suit installation. Bare stem shall be used for hydronic systems in non-corrosive applications.
 4. Connector: $\frac{3}{4}$ inch, with ASME B1.1 screw threads.
 5. Accuracy: Plus or minus 1 percent of scale range or one scale division, to maximum of 1.5 percent of scale range.
 6. See piping application schedule for thermometer range requirements based on system type.
- D. Digital Thermometer
1. Body: Molded plastic with variable angle mounting.
 2. Stem: Aluminum or brass and of a length to suit installation. Bare stem shall be used for hydronic systems in non-corrosive applications.
 3. Connector: $\frac{3}{4}$ inch, with ASME B1.1 screw threads.
 4. Display: Digital
 5. Accuracy: Plus or minus 2 deg F.
 6. Provide thermowell compatible with thermometer based on pipe diameter and system of installation.
 7. See piping application schedule for thermometer range requirements based on system type.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Piping shall be stored to prevent debris from entering the piping. This shall consist of piping caps or temporary covers.
- B. Above or below grade piping that is roughed in shall have a temporary cap installed to prevent debris from entering the piping system. The cap shall be removed to allow for the final connection or continuation of piping to be installed.
- C. Install piping at approximate locations indicated, and at maximum height.
- D. Install piping clear of door swings, and above sash heads.
- E. Make allowances for expansion and contraction.
- F. Install expansion loops in PEX piping as recommended by manufacturer.

- G. Allow for a minimum of 1" free air space around pipe or pipe covering, unless otherwise specified.
- H. Install all underground piping outside the footprint of the building to meet the minimum cover and distance below the frost depth requirements listed below:
 - 1. Sanitary and Storm – 48" minimum cover (below frost depth)
 - 2. Domestic water service – 12" below frost depth of the local jurisdiction or 60" deep, whichever is greater.
- I. Install horizontal piping with a constant pitch, and without sags or humps.
 - 1. Water Piping: Pitch 1/4" per 10 feet upward in direction of flow, unless otherwise noted. If it is not possible to maintain constant pitch, establish a new low point and continue. At the low point, provide a 1/2" drip leg and gate valve with a hose bibb end. Provide an air vent at the high point.
 - 2. Sanitary Piping: Pitch piping 3" and Under 1/4" per foot downward, in direction of flow, unless otherwise noted. Pitch piping 4" and Over 1/8" per foot downward, in direction of flow, unless otherwise noted.
 - 3. Grease Sanitary Piping: Pitch piping 1/4" per foot downward, in direction of flow, unless otherwise noted.
 - 4. Vent Piping: Pitch 1/8" per foot upward, unless otherwise noted.
- J. Install vertical piping plumb.
- K. Use fittings for offsets and direction changes, except for Type K soft annealed copper temper water tube, and mechanically extracted joints in Type L copper tubing.
- L. Cut pipe and tubing ends square; ream before joining.
- M. Threading: Use American Standard Taper Pipe Thread Dies.
 - 1. Thread brass pipe with special brass threading dies.
- N. PEX shall only be allowed individual branch or fixture piping, not mains connecting more than one (1) room.
 - 1. PEX piping shall not be installed in rated walls or ceiling spaces being used as a return air plenum.
 - 2. PEX piping shall not be installed where exposed, this includes mechanical rooms.

3.2 DRAINAGE SYSTEMS

- A. Fittings
 - 1. Long Sweep Fittings
 - a. Long sweep fittings shall be those in the category where 4" diameter piping has a minimum R/D = 10.5"/4".
 - b. Use long sweep drainage pattern fittings for all fittings unless noted otherwise.

- c. Use of other fittings must be approved by Engineer in writing prior to use.
 - 2. Short Sweep Fittings
 - a. Short sweep fittings shall be those in the category where 4" diameter piping has a minimum R/D = 7.5"/4".
 - b. Short sweep drainage pattern fittings may be used for the following.
 - 1) Vent piping.
 - 2) Fixture connections.
 - 3) Other locations as approved by the Engineer in writing.
 - 3. Vertical Offsets: Make vertical offsets with 45° elbows, or 1/8 bends.
- B. Cleanouts
- 1. Install cleanouts with sufficient side and end clearance to allow for the removal of the cleanout plug, and the use of cleaning tools.
 - 2. Lubricate cleanout plugs with anti-seize lubricant.

3.3 DOMESTIC WATER PIPING SYSTEM

- A. Connect branch lines to the upper quadrant of the main, and run upward at not less than 45° before extending laterally.
- B. Make final connections to plumbing fixtures and equipment with unions, or flanges.
 - 1. Do not use unions in ferrous piping larger than 3".
 - 2. Do not use unions in brass or copper piping larger than 2-1/2".

3.4 PIPE JOINT MAKE-UP

- A. Threaded Joint: Make up joint with a pipe thread compound applied in accordance with manufacturer's printed application instructions for the intended service.
 - 1. Chrome Plated Brass Pipe: Tighten joint with a strap or Parmalee wrench; do not mar pipe finish. Install piping so that no threads are visible.
- B. Soldered Joint: Thoroughly clean tube end and inside of fitting with emery cloth, sand cloth, or wire brush. Apply flux to the pre-cleaned surfaces. Install fitting, heat to soldering temperature, and join the metals with type of solder specified. Remove residue.
- C. Flanged Pipe Joint
 - 1. Install threaded companion flanges on steel pipe; flanges on galvanized pipe are not required to be galvanized.
 - 2. Provide a gasket for each joint.
 - a. Hot Water Pipe Gasket: Coat with a thin film of oil before making up joint.
 - 3. Coat bolt threads and nuts with anti-seize lubricant before making up joint.

- D. Caulked Joint: Pack hub with joint packing specified, and caulk. Run 12 ounces molten lead for each inch of pipe diameter. Caulk cooled lead ring and face off smoothly.
- E. Rubber Ring Push-on Joint: Clean hub, bevel spigot, and make up joint with lubricated gasket in conformance with the manufacturer's printed installation instructions.
- F. Grooved Pipe Joint: Roll groove pipe ends, make up joint with grooved end fittings and couplings, in conformance with the manufacturer's printed installation instructions.
 - 1. Cut grooved end piping is not acceptable.
- G. Hubless CI Pipe Joint: Make up joint with hubless fitting and couplings, in conformance with the manufacturer's printed installation instructions.
- H. Mechanical Joint: Make up joint in conformance with the manufacturer's printed installation instructions, with particular reference to tightening of bolts.
- I. Mechanical Press Joint: Install joint with tool approved by joint manufacturer. Installer shall be fully trained and have experience in installing this type of joint.
- J. PEX Joint: Cut pipe and install joints with tool approved by joint manufacturer. Installer shall be fully trained and have experience in installing this type of joint.
- K. Dissimilar Pipe Joint
 - 1. Joining Bell and Spigot and Threaded Pipe: Install a half coupling on the pipe or tube end to form a spigot, and caulk into the cast iron bell.
 - 2. Joining Dissimilar Threaded Piping: Make up connection with a threaded coupling or with companion flanges.
 - 3. Joining Dissimilar Non-Threaded Piping: Make up connection with adapters recommended by the manufacturers of the piping to be joined.

3.5 PIPING PENETRATIONS

- A. Install pre-manufactured flexible boots for vent terminations through roof. Use materials compatible with roof system.
- B. Sleeve Schedule: Unless otherwise shown, comply with the following schedule for the type of sleeve to be used where piping penetrates wall or floor construction:

CONSTRUCTION	SLEEVE TYPE
1. Frame construction.	None Required
2. Foundation walls.	A*
3. Non-waterproof interior walls.	B*
4. Non-waterproof interior floors on metal decks.	D*
5. Non-waterproof interior floors not on metal decks.	B*
6. Floors not on grade having a floor drain.	A
7. Floors over mechanical equipment, steam service, machine, and boiler rooms.	A

8.	Floors finished or to be finished with latex composition or terrazzo, and on metal decks.	D*
9.	Floors finished or to be finished with latex composition or terrazzo, and not on metal decks.	A
10.	Earth supported concrete floors.	None Required
11.	Exterior concrete slabs on grade.	A
12.	Fixtures with floor outlet waste piping.	None Required
13.	Metal roof decks.	C
14.	Non-metal roof decks.	A
15.	Waterproof floors on metal decks.	D
16.	Waterproof floors not on metal decks.	A
17.	Waterproof walls.	A

*Core drilling is permissible in lieu of sleeves where marked with asterisks.

C. Diameter of Sleeves and Core Drilled Holes

1. Unless otherwise specified, size holes thru floors and walls in accordance with the through penetration fire stopping system being used.
2. Size holes thru exterior walls or waterproofed walls above inside earth or finished floors, and exterior concrete slabs in accordance with the following:
 - a. Uninsulated (Bare) Pipe: Inside diameter of sleeve or core drilled hole 1/2" greater than outside diameter of pipe, unless otherwise specified.
 - b. Insulated Pipe: Inside diameter of sleeve or core drilled hole 1/2" greater than outside diameter of insulation, unless otherwise specified.
 - c. Mechanical Modular Seals: Size holes in accordance with the manufacturer's recommendations.

D. Length of Sleeves (except as shown otherwise on Drawings)

1. Walls and Partitions: Equal in length to total finished thickness of wall or partition.
2. Floors, Finished: Equal in length to total finished thickness of floor and extending 1/2" above the finished floor level, except as follows:
 - a. In furred spaces at exterior walls, extend sleeve 1" above the finished floor level.
3. Exterior Concrete Slabs: Equal in length to total thickness of slab and extending 1/2" above the concrete slab.
4. Roofs: Equal in length to the total thickness of roof construction, including insulation and roofing materials, and extending one inch above the finished roof level.

E. Packing of Sleeves and Core Drilled Holes

1. Unless otherwise specified, pack sleeves or cored drilled holes in accordance with Section 07 84 00 - FIRESTOPPING.

2. Pack sleeves in exterior walls below grade and concrete floor slabs at or below with mechanical modular seals.

3.6 ESCUTCHEONS

- A. Install plates for exposed uninsulated piping passing thru floors, walls, ceilings, and exterior concrete slabs as follows:
 1. In Finished Spaces: chrome plated cast brass.
 2. Unfinished Spaces (Including Exterior Concrete Slabs): unplated cast iron.
 3. Fasten plates with set screws.
 4. Plates are not required in pipe shafts or furred spaces.

3.7 PIPE AND FITTING SCHEDULE

- A. Refer to Drawings for Piping Application Schedule.
- B. Where options are given, choose only one (1) option for each piping service. No deviations from the selected option will be allowed.

END OF SECTION

SECTION 22 3300 - DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the following Domestic Water Heaters indicated by the Contract Documents with supplementary items necessary for proper installation.

1.2 REFERENCES

- A. Water heater shall be UL listed and labeled.
- B. Water heater shall bear the seal of the American Gas Association.
- C. Comply with the Iowa State Energy Code.
- D. Water heater performance shall meet the adopted version of ASHRAE 90.1.
- E. Water heaters serving emergency fixtures shall meet all requirements of ANSI Z358.1 for tepid water.

1.3 SUBMITTALS

- A. Product Data: Catalog sheets, specifications and installation instructions for each water heater, gas vent pipe, fittings, and accessories required for the vent system.

1.4 WARRANTY

- A. Manufacturer's Warranty: Three (3) year warranty for the glass lined water heater tank. Provide a copy of the warranty as part of the closeout documents.

PART 2 - PRODUCTS

2.1 TANK TYPE WATER HEATERS

- A. Acceptable Manufacturers
 - 1. A.O. Smith
 - 2. Bradford White
 - 3. Bock Water Heaters
 - 4. Laars
 - 5. PVI
 - 6. RBI

7. Rheem / Ruud
 8. State
- B. Tank: Welded steel, factory tested at 300 psi and rated for 160 psi working pressure.
1. Glass lining permanently bonded to tank interior surface.
 2. Tank nipples factory installed.
 3. Maintenance-free powered, renewable magnesium anode.
 4. Corrosion resistant dip tube.
 5. Drain and relief valve tapping.
 6. Renewable bronze boiler drain.
- C. Capacity of water heaters shall be as scheduled on the drawings.
- D. Water heaters shall be supplied with factory Pressure-Temperature Relief Valves sized for the specific application. Valves shall be AGA Z21.22 compliant; bronze body with stainless steel internals and threaded blow-off connection. Valves shall be field installed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the Work of this section in accordance with the manufacturer's printed installation instructions, unless otherwise specified.
- B. Install the water heater on a level, firm base.
- C. Install the pressure-temperature relief valve in the dedicated tank tapping. Pipe the relief valve blow-off to a point 6 inches above the floor, or as shown on drawings.
- D. Install unions and shut-off valves on hot and cold water connections. Install dielectric unions if required.
- E. Flush and fill tank. Do not switch on heating elements until tank is full and entrapped air is eliminated. Install the Work of this section in accordance with NFPA 54, NFPA 211, and the manufacturer's printed installation instructions, unless otherwise specified.
- F. Install an AGA lubricated plug valve on the gas connection. Gas supply branch shall have a 6" dirt leg with a threaded cap.
- G. Vent Piping
1. Support horizontal piping on five (5) foot centers, maximum spacing, support vertical piping at every floor or ten (10) foot intervals maximum.
 2. Terminate vent extension through roof with a bird proof vent top.

END OF SECTION

SECTION 22 4000 – PLUMBING FIXTURES AND EQUIPMENT INSTALLATION

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the following Plumbing Fixtures and Equipment indicated by the Contract Documents with supplementary items necessary for proper installation.

1.2 REFERENCES

- A. Refer to the Plumbing Material Lists and Equipment Schedules for additional capacity and equipment requirements.

1.3 SUBMITTALS

- A. Fixture and Equipment Data: Catalog sheets, specifications, rough-in dimensions, and installation instructions for each item specified except fasteners.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements
 - 1. Comply with the most recent version following standards:
 - a. Safe Drinking Water Act (SDWA) and the associated lead content requirements.
 - b. Applicable sections of ANSI/ASME A112 – Standards for Plumbing Equipment
 - 2. Materials and installations designated as handicapped accessible shall conform with the following:
 - a. ANSI A117.1 - Buildings and Facilities - Providing Accessibility and Usability for Physically Handicapped People.
 - b. The Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG), (Appendix A to 28 CFR Part 36).
 - 3. Each fixture carrier support shall be listed by model number in the fixture support manufacturer's Fixture Support Selection Guide as being recommended for support of the appropriate fixture.
- B. Plainly and permanently mark each fixture and fitting with the manufacturer's name or trade mark.

1.5 MAINTENANCE

- A. Special Tools: Deliver to the Owner.
 - 1. Furnish the following tools labeled with names and locations where used.
 - a. Keys for stops (furnished with stops).
 - b. Tools for Vandal Resistant Fasteners: Two (2) for each type and size.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. The following manufacturers are considered equal to the basis of design listed in the material list and schedules. The basis of design is preferred and will take precedence. Any products from an alternate approved manufacturer need to meet the requirements and performance specified and shall be equal to the basis of design.

Equipment	Acceptable Manufacturers
Backflow	Apollo/Conbraco, Watts/Febco/Ames, Zurn/Wilkins
Domestic Water Circulation Pumps	Armstrong, Bell & Gossett, Grundfos, Taco
Drainage Fixtures	Josam, Mifab, Smith, Sun, Wade, Watts, Zurn
Electric Water Coolers	Acorn, Elkay, Halsey Taylor, Haws, Murdock, Oasis
Expansion Tanks	Amtrol, Armstrong, Bell & Gossett, Elbi, Taco, Watts
Filter	Culligan, Everpure, Marlo, PEP, Watts
Fixture Carriers	Jay R. Smith, Josam, Mifab, Zurn
Grease Interceptor (Polyethylene)	Green Turtle, Mifab, Schier, Rockford, Zurn
Hose Bibbs & Misc. Valves	Apollo, Smith, Watts, Willoughby, Woodford, Zurn
Lavatories, Urinals, Water Closets (Fixtures)	American Standard, Eljer, Kohler, Sloan, Toto, Zurn
Lavatory & Sink Trim	American Standard, Chicago Faucet, Delta Commercial, Kohler, Moen Commercial, T&S Brass, Sloan, Zurn
Mixing Valves	Armstrong, Bradley, Lawler, Leonard, Powers
Mop And Service Sinks	Fiat, Stern-Williams, Zurn
Stainless Steel Sinks	Elkay, Just, Kohler
Wall Boxes	Guy Gray, LSP, Oatey, Sioux Chief

- B. All items shall be commercial grade unless specified otherwise.
- C. All items shall be supplied by the same manufacturer.

2.2 FIXTURE MATERIALS

- A. Vitreous China: First quality, smooth, uniform color and texture, with fused on glaze covering surfaces exposed to view.

1. Surfaces shall be free of chips, craze, warpage, cracks and discolorations. Surfaces in contact with walls or floors shall be flat, with warpage not to exceed 1/16 inch per foot.
 2. Color: White.
- B. Porcelain Enameled Cast Iron: Smooth, uniform color and texture, having fused on glaze covering surfaces exposed to view.
1. Material shall show no cracks, chips, craze or discolorations.
 2. Enameled surfaces shall be acid resistant unless otherwise specified.
 3. Color: White.
- C. Fixture Trim: Brass, bronze, or stainless steel construction; consisting of supply and waste fittings, faucets, traps, stop valves, escutcheons, sink strainers, nipples, supplies, and metal trim.
1. Brass piping: IPS standard weight, with standard weight, 125 lb cast brass fittings.
 2. Brass tubing: 18 B & S gauge.
 3. Stainless steel: 18-8 Type 302 or 304 unless otherwise specified.
- D. Fixture Trim Finishes:
1. Brass or Bronze: Polished or satin finished chrome plating, 0.02 mil chromium over 0.2 mil nickel plating.
 2. Stainless Steel: Invisible welds and seams, and unless otherwise specified, polished to No. 4 commercial finish.
- E. Fixture Hold-down Bolts: Steel, plated for corrosion resistance.
1. Cap nuts: Metal, polished and chrome plated.

2.3 FIXTURE SUPPORTS AND SUPPORTING DEVICES FOR LAVATORIES, SINKS, AND EQUIPMENT

- A. General: Ferrous metal members of carriers and supporting devices, with the exception of chrome plated or porcelain enameled cast iron, shall be factory painted for corrosion resistance.
- B. Floor Mounted Carrier Supports: Steel pipe uprights, 1-1/4 inch IPS minimum diameter, or 1 inch x 2 inch steel tubing uprights, with cast iron or welded steel feet, drilled for bolting to the floor construction. Each carrier shall be provided with the appropriate fixture supporting devices specified, or recommended by the carrier manufacturer's Fixture Support Selection Guide. Floor mounted carrier supports for banks of multiple adjacent fixtures shall have provisions in the support uprights to allow for waste piping to be concealed in the associated wall.
2. Concealed Arms: Steel, with fixture locking lugs, leveling screws and a means of attaching, positioning and securing the fixture to the carrier.
 - a. Trim: Polished, chrome plated metal escutcheon to space fixture two inches from the wall.

3. Exposed Arms: Cast iron or steel, porcelain enamel finished, with locking lugs, and leveling screws. Include studs, nuts and washers for fixture to be supported.
 - a. Trim: Polished and chrome plated metal cap nuts and washers.
 - b. Vandal Resistant Trim: Polished, chrome plated metal cap nuts and washers retained with vandal resistant set screws or other approved means of securing trim.
- C. Wall Mounted Carrier Supports: Plate type system, with steel plates on both sides of the wall and through-bolted. On walls having an integral finish, a single plate wall carrier designed for such installations may be used. Each carrier shall be provided with the appropriate fixture supporting devices specified, or recommended by the Carrier manufacturer's Fixture Support Selection Guide.
1. Concealed Arms: Steel, with fixture locking lugs, leveling screws and a means of attaching, positioning and securing the fixture to the carrier.
 - a. Trim: Polished, Chrome plated metal escutcheon to space fixture two inches from the wall.
 2. Exposed Arms: Cast iron or steel, porcelain enamel finished, with locking lugs, and leveling screws. Include studs, nuts, and washers for fixture to be supported.
 - a. Trim: Polished and chrome plated metal cap nuts and washers.
 - b. Vandal Resistant Trim: Polished, chrome plated metal cap nuts and washers retained with vandal resistant set screws.
- D. Bearing Plate: Steel, minimum 1/8 inch thick, and provided with bearing studs, nuts and appurtenances required by the fixture to be supported.
1. Fixture Hanger: Furnished by the fixture manufacturer.
- E. Wood Stud Filler Piece: 2 inch x 8 inch wood planking cut to fit between wood studding. Fasten with four 3/8 inch x 2-1/2 inch lag bolts with washers.
- F. Urinal Carriers
1. Floor Mounted Carrier Support (For Wall Hung Urinals): 1-1/4 inch ips steel pipe upright supports with block feet arranged with provisions for bolting to the floor slab, and with the following:
 - a. Hanger Plate: Steel, height adjustable with provisions for mounting and positioning the fixture hanger.
 - b. Bearing Plate: Steel, adjustable, with bearing studs, nuts and washers.
 - c. Studs, Nuts and Washers: Steel, treated for corrosion resistance.
 - d. Fixture Washers: Plastic.
 - e. Stud thread protectors.
 - f. Factory Painted.
 - g. Trim: Polished chrome plated metal cap nuts and washers.
 - h. Vandal Resistant Trim: Polished chrome plated metal cap nuts and washers retained with vandal resistant set screws.
 2. Floor mounted carrier supports for banks of multiple adjacent fixtures shall have provisions in the support uprights to allow for waste piping to be concealed in the associated wall. Ferrous metal members of carriers and supporting devices with the exception of chrome plated or porcelain enameled cast iron shall be factory painted for corrosion resistance.

2.4 GREASE INTERCEPTORS

- A. Standard: ASME A112.14.4, for automatic intercepting and removal of fats, oils, and greases from food preparation or processing wastewater.
- B. Body Material: Polyethylene
- C. Interior Separation Device: Baffles
- D. Inlet and Outlet Size: As noted on the drawings
- E. Cleanout: Integral or Field Installed
- F. Mounting: Below Grade.
- G. Flow-Control Fitting: Required
- H. Access: Provide manhole access where installed below concrete.
- I. Provide all necessary fittings, manhole access and accessories needed for complete installation.

2.5 CIRCULATING WATER PUMPS

- A. In-Line Pump: Pump to be UL listed & rated to a pressure of 125 PSI at 225 degrees Fahrenheit. Pump shall be a sealed wet rotor design, shaft and bearings shall be ceramic and lubricated by the system fluid. Motor shall be non-overloading with thermal overload protection. Pump volute shall be of stainless steel or bronze suitable for domestic hot water. Refer to the schedule and details on the drawings for additional installation, capacity and construction requirements.

2.6 CLEANOUTS

- A. Threaded pipe fitting or cast iron ferrule with gas tight cleanout plug.
- B. Plug: Cast brass or bronze, with threaded end, and raised or countersunk head. Tapped head for attachment of cleanout wall or deck plate covers where required.
- C. Covers: See Plumbing Material List.
- D. Anti-Seize Lubricant: Never-Seez by Bostik Chemical Group, Molycote 1000 by Dow Corning Corp, Anti-Seize Lubricant by Loctite Corp
- E. Membrane flange and clamping collar, secured with corrosion resistant fasteners.

2.7 AIR GAP FITTINGS

- A. Provide when called for in Plumbing Material List.
- B. Coated cast iron body with air gaps, set screw or threaded inlet, and outlet connection to match piping option selected.

2.8 DRAIN VALVES

- A. Provide on all equipment with drain connections and as shown on details.
- B. Cast brass body with renewable units, hose bibb vacuum breaker (ASSE 1011) with drainage feature, and removable cast iron handwheel with vandal resistant fastener.
 - 1. Valve must be completely assembled to make hose connection.
 - 2. Connections: 1/2 or 3/4 inch threaded or solder end inlet, and 3/4 inch hose bibb outlet.

2.9 WALL BOX WITH VALVES

- A. Box and faceplate shall be 20 gauge, white powder-coated, cold-rolled steel.
- B. The valve shall be brass, quarter-turn, lead-free valve complying with NSF 61, NSF 372, and ASME A112.18.1. Valve shall be marked for identification as lead free.

PART 3 - EXECUTION

3.1 FIXTURE SUPPORT AND SUPPORTING DEVICE INSTALLATION

- A. Install heavy duty floor mounted carrier supports with specified fixture supporting devices for wall type plumbing fixtures.
 - 1. Secure to building construction with lag bolts and metal expansion shields, or other appropriate means as required by the construction encountered.
- B. Attach fixtures to floor or wall construction as specified in the Plumbing Material List.
- C. Fixture Supporting Devices: Attach fixtures by means of the following fixture supporting devices attached to carrier supports.

FIXTURE	SUPPORTING DEVICE
Lavatory, VC, with back	Concealed arms
Lavatory, VC, no back	Concealed arms
Lavatory, ECI, with back	Exposed arms
Lavatory	Concealed arms
Lavatory	Through bolt
Urinal	Fixture hanger and bearing plate
Water Cooler (wall mounted)	Fixture hanger

3.2 FIXTURE INSTALLATION

- A. Install the Work of this section in accordance with the manufacturer's printed installation instructions.

- B. See Architectural Floor Plans and Interior Elevation drawings for final installation locations and heights of all plumbing fixtures. Architectural plans supersede these specifications.
- C. Install fixtures level and at proper height, tighten connections, and install hold-down bolts, cap nuts and cover plates, where required.
- D. Caulk joint between all fixtures and wall or floor with sealant; strike a neat joint.
- E. Filters
 - 1. Provide adequate service clearance in front of and below units to allow for removal and replacement of filters.
 - 2. Include a shut off valve upstream of the filter to allow for service.
 - 3. Provide pressure gauges upstream and downstream of multi-stage filters to monitor pressure drop for filter replacement.
- F. Mop Service Sinks
 - 1. Set receptor leveled in bed of mortar laid on clean roughened surface. Remove excess mortar and strike a neat joint.
 - 2. Make connection from drainage pipe to receptor drain.
 - 3. Install service fittings and miscellaneous trim such as mop hanger and wall protection as called for on Plumbing Material List.
- G. Lavatories
 - 1. Mount lavatories 34 inches from finished floor to rim unless otherwise specified.
- H. Countertop Fixtures
 - 1. Install fixture with securing devices supplied.
 - 2. Set fixture on bedding of clear sealant, tighten securing devices and remove excess sealant.
- I. Water Closets
 - 1. Floor Supported Fixtures:
 - a. Set fixture in bed of setting compound; remove excess.
 - 2. After connections are tightened, install cap nuts and washers.
- J. Urinals
 - 1. Wall Hung Fixtures
 - a. Standard Fixtures: Install wall hung fixtures 24 inches from finished floor to rim.
 - b. Set bearing nuts on floor mounted carrier supports to position wall hung fixtures 1/16 inch clear of finished wall.
 - 2. After connections are tightened, install cap nuts and washers.

K. Flush Valves

1. Standard Fixtures: Install flush valves on fixture centerline, and at following heights above fixture rim or back to centerline of water inlet to flush valve.
 - a. Urinal: 11-1/2 inches.
2. Handicapped Accessible Fixtures: Install flush valves on fixture centerline, and at following height above finished floor to centerline of flush valve operator. Distance between centerline of flush valve operator and centerline of water inlet is 1-1/2 inches.
 - a. Urinal: Maximum 44 inches.
3. Slip joints in flush pipe connections allowed only at fixture spud and vacuum breaker ends; others shall be screwed connections.
4. Score tubing ends before assembling to assure tight slip joint connections. No score marks shall be visible after assembly.
5. In utility corridors, solder screwed flush pipe connections.

L. Floor drains

1. Install the Work of this section in accordance with the manufacturer's printed installation instructions, unless otherwise specified.
2. Protect weep holes from plugging during installation. Rod out weep holes after installation to remove obstructions.
3. Set drainage flange flush with top of structural floor slab, or at elevation otherwise indicated.
4. After membrane waterproofing installed and cured, secure clamping ring.
5. Adjust strainer head to height indicated. If height not indicated, set at 1/2 inch below finished floor elevation.

M. Drains and Inlets During Construction

1. Provide a temporary cover for all floor, roof, trench and area drains during construction to prevent debris getting into the system and protect drain grates. Remove temporary covers and clean grates at the end of construction.
2. The contractor is responsible for the flushing of all drains used during construction. This includes main and branch lines. If solids or debris in the system result in flow issues, the contractor will be required to camera and remove obstructions.

N. Wall Hydrants: Installation Height: Minimum 18 inches above finished grade.

O. Cleanout Plug: Lubricate threads with anti-seize lubricant before final installation.

P. Wall Boxes

1. Coordinate installation height and required millwork openings with architectural plans and millwork submittals.

3.3 PUMP INSTALLATION

- A. Install in-line circulating pumps between pipe flanges in piping systems. Install overhead pipe supports, both sides of in-line pumps, installed in horizontal piping runs.

3.4 CLEANING, FLUSHING AND ADJUSTMENT

- A. Clean fixtures and trim. Remove grease and dirt; polish surfaces but leave stickers and warning labels intact.
- B. Flush supply piping and traps; clean strainers.
- C. Adjust stops for proper delivery.

END OF SECTION

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SECTION 23 0500 – HVAC COMMON WORK RESULTS

PART 1 - GENERAL

1.1 SCOPE

- A. The work under this section includes basic mechanical requirements, which are applicable to all Division 21, 22 and 23 sections.
- B. Overview of work
 - 1. HVAC
 - 2. Plumbing
- C. In these documents, "Contractor" refers to the mechanical contractor and all their subcontractors, unless listed otherwise. The division of work within the mechanical scope is the responsibility of the lead mechanical contractor.
- D. Contractor is responsible for providing fully functional systems.
- E. If work is shown on the drawings or listed in the specifications, it shall be included by the Contractor.
- F. If equipment is provided by the Contractor, it shall be installed by the Contractor, unless noted otherwise.
- G. The drawings are necessarily diagrammatic by their nature and are not intended to show every connection in detail or every item in its exact location. Carefully investigate structural and finish conditions and coordinate the separate trades in order to avoid interference between the various phases of Work. Organize and lay out Work so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Install all Work parallel or perpendicular to building lines unless otherwise noted.
- H. The intent of the Drawings is to establish the types of systems and functions; not to set forth each item essential to the functioning of the system. Install the Work complete, including minor details necessary to perform the function indicated. Review pertinent Drawings and adjust the Work to conditions shown. Where discrepancies occur between Drawings, Specifications, and actual field conditions, immediately notify the Architect and Engineer for interpretations.
- I. All sizes as given are minimum except as noted.
- J. Materials shall be new (unless noted or stated otherwise), first class, and workmanlike, and shall be subject at all times to the Architect's, Engineer's, and Owner's observations from the commencement until the acceptance of the completed work.
- K. Kitchen Equipment
 - 1. Kitchen Equipment will be provided by the Kitchen Equipment Contractor (KEC) as outlined in the Kitchen Consultant's documents. Refer to the Kitchen Consultants documents for the description of work to be completed by the KEC as well as the various other contractors. This includes the mechanical, plumbing, and electrical contractors.

1.2 REFERENCES

- A. Applicable provisions of Division 0 and Division 1 govern work under this Section.
- B. All work shall conform to the most current version of all applicable codes and standards or the version adopted by the jurisdiction.
- C. Codes
 - 1. International Building Code
 - 2. International Mechanical Code
 - 3. Uniform Plumbing Code
 - 4. International Fuel Gas Code
 - 5. International Fire Protection Code
 - 6. International Energy Conservation Code
 - 7. NFPA – National Fire Protection Association
 - 8. State or City Codes for the City of Colfax, Iowa.
- D. Standards
 - 1. ASHRAE Standard 15
 - 2. ASHRAE Standard 62
 - 3. ASHRAE Standard 90.1
 - 4. SMACNA – Sheet Metal and Air Conditioning Contractors National Association, Inc.
 - 5. AMCA – Air Movement and Control Association
 - 6. ASME – American Society of Mechanical Engineers
 - 7. ANSI – American National Standards Institute
 - 8. ARI – Air Conditioning and Refrigeration Institute
- E. Governing Bodies
 - 1. Owner's Insurance Company
 - 2. State Fire Marshal
 - 3. AHJ – Authority Having Jurisdiction
 - 4. UL - Underwriters Laboratories

1.3 SUBMITTALS

- A. The review of shop drawings by the Engineer is for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Corrections or comments made on the shop drawings during this review do not relieve the contractor from compliance with the requirements of the plans and specifications. Approval of a specific item shall not include approval of an assembly of which the item is a component. The Contractor is responsible for: dimensions to be confirmed and correlated at the jobsite; information that pertains solely to the fabrication processes or to the means, methods, techniques, sequences and procedures of construction; coordination with the Work of all trades; and for performing all work in a safe and satisfactory manner.
- B. Refer to individual technical specification sections for specific submittal requirements.
- C. Submission of shop drawings electronically In .PDF format is preferred.
- D. If hard copies of shop drawings are utilized on this project, coordinate the quantity with the Architect and General Contractor. Provide one (1) copy for the Engineer's records.
- E. The Engineer will review one resubmittal for each product. If additional resubmittals are required, the Contractor shall be responsible to bear the cost for the Engineer to recheck and handle the additional shop drawing submittals. Documents will not be reviewed until payment is agreed upon.
- F. Contractor may request electronic AutoCAD files from the Engineer if needed to complete their shop drawings. An Electronic File Request Form will be sent to the contractor if files are requested and must be completed and signed before the AutoCAD files are released to the Contractor.
- G. All submittals for equipment and materials shall be reviewed and approved by the engineer prior to the fabrication or release by the contractor. This includes fabrication drawings for ductwork and fire protection and the coordination of equipment between trades. The release, purchase, installation or fabrication of any items prior to the contractor receiving an approved shop drawing will be at the contractor's own risk. Any rework that results will be provided by the contractor at no cost to the Owner or design team.
- H. Submittals must be reviewed and approved by the Contractor before submitting to the Engineer.
- I. Submittals shall be grouped to include complete submittals of related systems, products, and accessories in a single submittal. Mark dimensions and values in units to match those specified.

1.4 QUALITY ASSURANCE

- A. Warranty
 - 1. Equipment warranty shall be a minimum of one (1) year from date of factory supervised startup or from the date of substantial completion, whichever is later.
 - 2. Contractor shall warranty all of their work for one (1) year from the date of substantial completion.
- B. Equipment Capacity
 - 1. All equipment submitted shall meet or exceed the capacity listed in the specifications and

schedules. This includes airflows / static pressure, heating / cooling capacities, pump flow / head, and all values listed in the construction documents.

2. All submitted motor brake horsepower's submitted shall be at least 5% less than the rated nominal motor horsepower. No motors shall be selected in the motor service factor with the exception of fire pumps.
 3. The mechanical contractor shall be responsible for any structural, electrical, piping, ductwork or other utility modifications resulting from an alternate manufacturer than the basis of design being used.
- C. These documents are diagrammatical in nature and intended to convey scope and general arrangement of the mechanical systems. Not all fittings, risers, size changes, offsets, valves, accessories, etc. are shown on plan. If items are required to make a system fully operational but not shown on plan or in these specifications, they shall be included by the contractor.
- D. The intent of the Drawings is to establish the types of systems and functions; not to set forth each item essential to the functioning of the system. Install the Work complete, including minor details necessary to perform the function indicated. Review pertinent Drawings and adjust the Work to conditions shown. Where discrepancies occur between Drawings, Specifications, and actual field conditions, immediately notify the Architect and Engineer for interpretations.
- E. It is the contractor's responsibility to determine all utility routing prior to purchase and installation of material.
- F. The contractor shall report any discrepancies between these documents and site conditions immediately to the Engineer prior to submitting a bid or starting work. Submittal of a bid indicates that the contractor and the contractor's subcontractors have carefully and thoroughly reviewed the drawings, specifications, and other construction documents and have found them complete and free from ambiguities and sufficient for the purposes intended.
- G. Install all equipment per the manufacturer's requirements / recommendations.
- H. No equipment provided or installed shall contain mercury.
- I. Manufacturer Supplier Inspection & Startup
1. The following equipment shall have a factory representative perform start-up. The procedure shall be documented and submitted to the design team and Owner. Include copies of startup reports in the Operations & Maintenance Manuals.
 - 1) Make Up Air Unit
 - 2) Rooftop Units
- J. All equipment shall be UL listed where applicable.

1.5 ELECTRONIC DOCUMENT RELEASE

- A. Electronic versions of the bid documents will be made available to the contractors for use during the bidding process and to help generate fabrication drawings for various systems. A summary of the requirements for the various document types is listed below:
1. PDF
 - a. Contact the Construction Manager or Architect to obtain a PDF version of the Bid Documents. No Document Release Form is required.

2. AutoCAD

- a. KEDbluestone Engineering can provide an AutoCAD version of the bid documents for the contractor to use for generating shop drawings and fabrication drawings. This will include plan drawings with the architectural background. The contractor is responsible for incorporating any modifications that occur during bidding by all disciplines. Details and schedules will not be included.
- b. A document release form (see attached) will be required to be completed by the contractor to determine the version of AutoCAD and drawings required. No fee is associated with these drawings.

3. REVIT

- a. The REVIT drawings will be converted to AutoCAD and then transferred to the contractor.
- b. KEDbluestone Engineering can provide an AutoCAD version of the bid documents for the contractor to use for generating shop drawings and fabrication drawings. This will include plan drawings with the architectural background. The contractor is responsible for incorporating any modifications that occur during bidding by all disciplines. Details and schedules will not be included.
- c. A document release form (see attached) will be required to be completed by the contractor to determine the version of AutoCAD and drawings required.
- d. Submittal of the document release form will be required prior to the AutoCAD files being transmitted.

1.6 SUBSTITUTIONS

- A. All manufacturers listed as Acceptable Manufacturers in each specification section are considered equal to the basis of design. The basis of design is preferred and will take precedence. Any products from an alternate approved manufacturer need to meet the requirements and performance specified and shall be equal to the basis of design.
- B. The Contractor may request permission for a substitution of any item (equipment or material), subject to the following conditions:
 1. Submit substitution requests in writing to the Engineer, on a form supplied by the Engineer. A sample copy of this form is included at the end of this section. An electronic copy can also be provided to the Contractor by the Engineer.
 2. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contractor documents, the Contractor is responsible for all costs involved in integrating the equipment or accessories into the system and the assigned space and for obtaining the performance from the system into which these items are placed as well as any re-design costs incurred by the Architect or Engineer. The Contractor is also responsible for coordinating changes required by other trades.
 3. Any requests for alternate manufacturers must be submitted to the Architect/Engineer at least ten (10) days prior to bid day. Incomplete substitution requests will not be considered.
- C. Approval
 1. No work involving requests for substitution shall commence without written approval on the provided form by the Engineer.

2. Any work started or material ordered/installed by the Contractor without written approval shall be removed/repared at the sole expense of the contractor. The Contractor will also be responsible for any costs incurred by the Owner for such rework.

1.7 COORDINATION DRAWINGS

- A. The mechanical contractor shall be responsible for producing coordination drawings. The drawings will need to incorporate piping, ductwork, equipment, lighting, conduits, building structure and all other building and system components that will need to be coordinated for proper systems installation and operation.
- B. The drawings will be 1/4" scale.
- C. Coordination meetings will be conducted on site with all concerned contractors present. Representatives from the Owner, Architect and Engineer will also be present to review conflicts and approve contractor variations to the contract documents.

1.8 CONTINUITY OF EXISTING SERVICES AND SYSTEMS

- A. No outages shall be permitted on existing systems except at the time and during the interval specified by the Engineer and the Owner. Any outage must be scheduled when the interruption causes the least interference with normal work schedules and business routines. No extra costs will be paid to the Contractor for such outages which must occur outside of regular weekly working hours unless specifically noted in the Specifications or in the bidding requirements.
- B. This Contractor shall restore any mechanical services interrupted as a result of a lack of coordination to proper operation as soon as possible.
- C. Contractor shall notify Owner of any utility service shutdown forty-eight (48) hours in advance. This includes gas, water, sanitary, storm, fire protection, cooling, and heating systems.

1.9 REGULATORY AND UTILITY REQUIREMENTS

- A. Contractor is responsible for coordinating all required site inspections by authorities having jurisdiction. Contractor shall notify General Contractor of all scheduled inspections seven (7) working days prior to site visit.
- B. Contractor is responsible for paying for all fees, permits, and inspections that are required to complete their work.
- C. Contractor shall include all work required to relocate utilities and meters as shown on drawings.
- D. Contractor shall include all work required to install new utilities and meters as shown on drawings. This includes any new service and meter fees in coordination with the utility company.
- E. Utility work 5'-0" from outside of building is by others.

1.10 PROTECTION OF FINISHED SURFACES

- A. Furnish one (1) can of touch-up paint for each different color factory finish for equipment furnished by the Contractor. Deliver touch-up paint with other "loose and detachable parts" as covered in the General Requirements.

1.11 SEALING AND FIRESTOPPING

- A. Sealing and firestopping of sleeves/openings between ducts and piping and the structural or partition opening shall be the responsibility of the General Contractor. The contractor responsible shall hire individuals skilled in such work to do the sealing and firestopping. These individuals hired shall normally and routinely be employed in the sealing and fireproofing occupation.

1.12 WORK BY OWNER AND/OR OWNER AGENCY

- A. Asbestos abatement, removal and disposal, if required, will be by the Owner under separate contract.

1.13 OMISSIONS

- A. No later than ten (10) days before bid opening, the Contractor shall call the attention of the Architect and Engineer to any materials or apparatus the Contractor believes to be inadequate and to any necessary items of work omitted.

1.14 DELIVERY, STORAGE, AND HANDLING

- A. All equipment and materials shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.
- B. Store equipment indoors in clean dry space with uniform temperature to prevent condensation or damage from the elements.
- C. Take such precautions as are necessary to protect apparatus and materials from damage. Damaged equipment shall be, as determined by the Owner and/or Engineer, placed in first class operating condition or be returned to the source of supply for repair or replacement.
- D. Protect factory finish from damage during construction operations until acceptance of the Project. Restore any finishes that become stained or damaged to Owner's satisfaction.

1.15 DIVISION OF WORK AND COORDINATION

- A. The Electrical Contractor is responsible for providing and installing power wiring up to equipment provided by others for a single point connection. Internal wiring of equipment provided by others shall be the responsibility of the contractor responsible for providing and installing the equipment.
- B. Controls, disconnect switches, starters, variable frequency drives, etc. shall be provided and installed by the contractor noted on the plans and in the specifications. It is the responsibility of the Contractor to request written clarification for any ambiguity regarding division of work and coordination at least ten (10) days prior to bid.
- C. See Section 230900 for scope of wiring required for Temperature Control systems.
- D. Utilities routed within the building shall be installed in an orderly manner. All work will be coordinated with other disciplines prior to installation. The following list ranks the priority of the utilities to be installed:
 - 1. Light fixtures

2. Gravity piping
 3. Electrical busduct
 4. Ductwork
 5. Cable tray
 6. All other piping
 7. Electrical conduits
- E. Any installed work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.
- F. Coordinate work with the Testing and Balancing (TAB) Contractor. Verify system completion to the TAB Contractor such as pressure testing, chemical treatment, filling of liquid systems, proper pressurization and air venting of hydronic systems, clean filters, clean strainers, controls adjusted and calibrated, fire/smoke damper integration ready for testing, adjusting and balancing work. Install dampers, shutoff and balancing valves, flow measuring devices, gauges, temperature controls, etc., required for functional and balanced systems. Assist the TAB Contractor as needed to complete their work.
- G. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- H. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- I. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.16 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.
- B. In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation as applicable:
1. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
 2. A control sequence describing start-up, operation, and shutdown.
 3. Description of the function of each principal item of equipment.
 4. Installation instructions.
 5. Safety precautions for operation and maintenance.
 6. Diagrams and illustrations.

7. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers and replacement frequencies.
8. Performance data.
9. Where applicable, pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
10. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.

1.17 RECORD DRAWINGS

- A. The Contractor shall maintain at least one copy each of the Specifications and Drawings on the job site at all times.
- B. The Architect will provide the Contractor with a suitable set of Contract Drawings on which daily records of changes and deviations from contract shall be recorded. Dimensions and elevations on the record drawings shall locate all buried or concealed piping, conduit, or similar items.
- C. The daily record of changes shall be the responsibility of Contractor's field superintendent. No arbitrary mark-ups will be permitted.
- D. At completion of the project, the Contractor shall submit the marked-up record drawings to the General Contractor prior to final payment.

1.18 SPECIAL REQUIREMENTS

- A. Contractor bid shall allow color selection by Architect of any piece of exposed equipment from all available colors. Base bid color selection shall include those considered 'premium' by the manufacturer.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Conditions: Provide new products of manufacturers regularly engaged in production of such equipment. Provide the manufacturer's latest standard design for the type of product specified.

2.2 ACCESS PANELS AND DOORS

- A. Provide access panels and/or doors where required to maintain access to the electrical installation and where noted on the Drawings.
- B. Lay-in Ceilings
 1. Removable lay-in ceiling tiles in 2 x 2 foot or 2 x 4 foot configuration provided under other divisions are sufficient; no additional access provisions are required unless specifically indicated.

C. Plaster/Gypsum Walls and Ceilings

1. 16 gauge frame with not less than a 20 gauge hinged door panel, prime coated steel for general applications, stainless steel for use in toilets, showers and similar wet areas, concealed hinges, screwdriver operated cam latch for general application, key lock for use in public areas, UL listed for use in fire rated partitions if required by the application. Use the largest size access opening possible, consistent with the space and the equipment needing service; minimum size is 12" by 12".

2.3 SEALING AND FIRESTOPPING

A. Fire and/or Smoke Rated Penetrations

1. Manufacturers
 - a. 3M, STI/SpecSeal, Tremco, Hilti or approved equal.
2. All firestopping systems shall be by the same manufacturer.
3. Submittals
 - a. Contractor shall submit product data for each firestop system. Submittals shall include product characteristics, performance and limitation criteria, test data, MSDS sheets, installation details and procedures for each method of installation applicable to this project. For non-standard conditions where no UL tested system exists, submit manufacturer's drawings for UL system with known performance for which an engineering judgment can be based upon.
4. Product
 - a. Firestop systems shall be UL listed or tested by an independent testing laboratory approved by the Department of Commerce.
 - b. Use a product that has a rating not less than the rating of the wall or floor being penetrated. Reference architectural drawings for identification of fire and/or smoke rated walls and floors.
 - c. Contractor shall use firestop putty, caulk sealant, intumescent wrap strips, intumescent fire stop collars, fire stop mortar or a combination of these products to provide a UL listed system for each application required for this project. Provide mineral wool backing where specified in manufacturer's application detail.

B. Non-Rated Penetrations

1. Piping Penetrations Through Below Grade Walls
 - a. In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the piping and the cored opening or a water-stop type wall sleeve.
2. Piping and Ductwork Penetrations
 - a. At penetrations of non-rated interior partitions, floors and exterior walls above grade, use urethane caulk in annular space between pipe/duct and sleeve or opening.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations
- D. Install equipment to allow right of way for piping installed at required slope.
- E. Provide clearance for inspection, repair, replacement, and service to all equipment to include a minimum of 36 inches from all obstructions (walls, structure, ductwork, pipes, etc.). Clearance shall maintain access to all electrical panels, access doors, controllers, valves, junction boxes and operators and include the area directly in front of and above the system components.

3.2 EXCAVATION AND BACKFILL

- A. Perform all excavation and backfill work to accomplish indicated mechanical systems installation in accordance with Section 312316.13 - Trenching.

3.3 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases not less than 4 inches larger in both directions than supported unit.
 - 2. All pads to be a minimum of 4" thick unless noted otherwise. Thicken pads as needed to accommodate the slope of slab / grade around the equipment. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Indoor or outdoor equipment meeting any or all of the following requirements shall be installed on housekeeping pads:
 - a. Floor mounted motorized equipment.
 - b. All floor or ground mounted air handling equipment and fans.
 - c. All heating, cooling, plumbing, and fire protection equipment and associated floor mounted accessories located in mechanical spaces.
 - d. Equipment installed in areas with uneven surfaces and surfaces that are not level.
 - e. As required by the equipment manufacturer
 - 8. Refer to plans and details for additional pad locations.

3.4 PAINTING

- A. Exposed piping in occupied areas to be painted by others. Coordinate color with architect.
 - 1. Contractor to prep duct and piping as needed to accept paint.
- B. Contractor shall paint the following items with two (2) coats of exterior enamel over one (1) coat primer. Select paint to be compliant with material being used, i.e. metal, plastic, etc:
 - 1. All exposed natural gas piping. Color to be coordinated with the Architect.

3.5 SEALING AND FIRESTOPPING

- A. Fire and/or Smoke Penetrations
 - 1. Install approved product in accordance with the manufacturer's instructions where a pipe/duct penetrates a fire rated surface.
 - 2. Where firestop mortar is used to infill large fire-rated floor openings that could be required to support weight, provide permanent structural forming. Firestop mortar alone is not adequate to support any substantial weight.
- B. Non-Rated Surfaces
 - 1. When the opening is through a non-fire rated wall, floor, ceiling or roof the opening must be sealed using an approved type of material.
 - 2. Install escutcheons or floor/ceiling plates where pipe/duct penetrates non-fire rated surfaces in occupied spaces. Occupied spaces for this paragraph include only those rooms with finished ceilings and the penetration occurs below the ceiling.
 - 3. In exterior wall openings below grade, assemble rubber links of mechanical seal to the proper size for the pipe/duct and tighten in place, in accordance with the manufacturer's instructions. Install so that the bolts used to tighten the seal are accessible from the interior of the building or vault.
 - 4. At interior partitions, pipe/duct penetrations are required to be sealed for all clean rooms, laboratories, and most hospital spaces, computer rooms, dormitory rooms, telephone/data/com rooms and similar spaces where the room pressure or odor transmission must be controlled. Apply sealant to both sides of the penetration in such a manner that the annular space between the sleeve and the pipe/duct is completely filled.

3.6 HOUSEKEEPING AND CLEAN UP

- A. The Contractor shall clean up and remove from the premises, on a daily basis, all debris and rubbish resulting from its work and shall repair all damage to new and existing equipment resulting from its work. When job is complete, this Contractor shall remove all tools, excess material and equipment, etc., from the site.

3.7 SITE OBSERVATIONS

- A. Site observations shall be performed by the Engineer at the following project milestones:
 - 1. Prior to enclosure of the following areas:

- a. Underfloor
- b. Walls and chases
- c. Raised floor
- d. Above the ceiling

2. Final project completion

- B. Contractor shall provide seven (7) working days' notice to Engineer prior to site visit.
- C. The Engineer is only responsible to conduct one (1) final site visit. If upon visiting the site, the Engineer finds that not enough work is complete for the final site visit, the Contractor shall be responsible to bear the cost for the Engineer to travel to the site and revisit. Revisiting will not occur until payment is agreed upon.

3.8 EQUIPMENT STARTUP

- A. Contractor shall provide startup of equipment by factory certified personnel for equipment listed above.
- B. For all other equipment, Contractor shall perform startup per manufacturer's requirements. Startup shall be performed by personnel qualified for this work.
- C. Contractor shall test equipment to be fully functional. Test all equipment safeties and emergency stops. Test all control set-points and equipment modes.
- D. Contractor shall return to site as needed to adjust equipment for seasonal equipment performance changes.

3.9 OWNER TRAINING

- A. Contractor shall include at least eight (8) hours for each maintenance staff shift group in their bid to provide complete Owner training for all the mechanical systems. Training shall include explanation of system operation, startup/shutdown, routine maintenance, seasonal changes, and controls adjustments. Coordinate acceptable training schedule with Owner.
- B. All training provided for the Owner shall comply with the format, general content requirements and submission guidelines specified under Section 019101, or 019102.
- C. Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for the duration noted in the technical Specifications.

3.10 PROJECT CLOSEOUT REQUIREMENTS

- A. Final project closeout tasks
 - 1. Deliver all spare parts listed in each specification section. Deliver to Owner chosen location.
 - 2. All equipment labeled per specifications.
 - 3. All equipment cleaned and ready for use. Install new filters in all equipment with filters; do not use Owner's spare filter sets.

B. Contractor requirements

1. Marked up drawings and specifications provided to Engineer for incorporation of as-built drawings or to serve as the as-built drawings depending on the project requirements. As-built drawings shall be clean and legible.
2. Operation and Maintenance (O & M) Manuals shall include the following:
 - a. Contractor contact for warranty work
 - b. Approved shop drawings, incorporating all review comments
 - c. Warranty copies
 - d. Equipment start-up reports
 - e. Testing and balancing reports
 - f. Operation and maintenance instructions
3. Utility Rebate Forms
 - a. Contractor shall submit completed energy rebate forms for each piece of equipment that is eligible for a rebate. Eligible equipment shall include, but not be limited to the following:
 - 1) Rooftop Air Conditioning Units
 - 2) Makeup Air Units
 - 3) Building Automation System
 - b. Contractor to complete information regarding equipment. Submit form to Owner, Owner will complete Owner's contact information and send the completed form to the utility.
4. Three (3) final approved O & M Manuals shall be delivered to Owner. Each manual shall be an appropriately sized three (3) ring binder with a vinyl cover and printed spine and cover labels. Each section shall have a printed divider tab. Each section shall be listed in a table of contents at the beginning of the manual.

END OF SECTION

(ELECTRONIC DOCUMENT RELEASE FORM & SUBSTITUTION REQUEST FORMS ATTACHED)

Document Release Form

Information Requested:

Project Name:
Drawings Requested:

Media Type: (Check all that are applicable)

- | | |
|--|--|
| <input type="checkbox"/> AutoCAD DWG Files (Version _____) | <input type="checkbox"/> Adobe PDF Files |
| <input type="checkbox"/> REVIT Files (Version _____) | <input type="checkbox"/> Other |

Requesting Party:

Name:	Address 1:
Company:	Address 2:
Signature:	Email Address:
Date:	Phone #:

KEDbluestone Use:

Form Sent By: _____ Date: _____

KEDbluestone Project #:

Data contained on these electronic files are part of our instruments of service and shall not be used by you or anyone else receiving these data through or from you for any purpose other than as a convenience in the preparation of shop drawings for the referenced project. Any other use or reuse by you or by others will be at your sole risk and without liability or legal exposure to us. You agree to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against us, our officers, directors, employees, agents or sub consultants that may arise out of or in connection with your use of the electronic files. Furthermore, you shall, to the fullest extent permitted by law, indemnify and hold us harmless against all damages, liabilities or costs, including reasonable attorneys' fees and defense costs, arising out of or resulting from your use of these electronic files. These electronic files are not construction documents. Differences may exist between these electronic files and corresponding hard-copy construction documents. We make no representation regarding the accuracy or completeness of the electronic files you receive. In the event that a conflict arises between the signed or sealed hard-copy construction documents prepared by us and the electronic files, the signed or sealed hard-copy construction documents shall govern. You are responsible for determining if any conflict exists. By your use of these electronic files, you are not relieved of your duty to fully comply with the contract documents, including, and without limitation, the need to check, confirm and coordinate all dimensions and details, take field measurements, verify field conditions and coordinate your work with that of other contractors for the project. Because information presented on the electronic files can be modified, unintentionally or otherwise, we reserve the right to remove all indicia of ownership and/or involvement from each electronic display.

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SUBSTITUTION REQUEST FORM (DURING BIDDING)

We submit for your consideration the following product instead of the specified item for the following project:

PROJECT: _____

SPEC. SECTION	SPEC. TITLE	PARAGRAPHS	SPECIFIED ITEM
_____	_____	_____	_____

Proposed Substitution: _____

MANUFACTURER	TRADE NAME	MODEL NO.
_____	_____	_____

Attached data includes product description, specifications, drawings, photographs, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including Architectural and Engineering design, detailing, and construction costs caused by the substitution.

Submitted by:

Signature

Firm

Email Telephone
Date

Engineer's Review and Action

- ☐ Substitution Approved
- ☐ Substitution Approved As Noted
- ☐ Substitution Rejected
- ☐ Substitution Request Received Too Late

Signed by:

Date

Supporting Data Attached:

☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ Other _____

SECTION 23 0529 – PIPE HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the following Pipe Hangers and Supports indicated by the Contract Documents with supplementary items necessary for proper installation.

1.2 REFERENCES

- A. Refer to Section 230719, PIPING INSULATION for work related to this section.

1.3 SUBMITTALS

- A. Product Data
 - 1. Manufacturer's catalog sheets and specifications for hangers and supports materials.
 - 2. Installation instructions.
 - 3. Schedule indicating what type of hangers or support will be used for various piping types.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with the applicable requirements of the ASME B31 Piping Codes.
 - 2. Unless otherwise shown or specified, comply with the requirements of the Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS) Standards SP-58, and SP-69.
 - 3. Hang and support cast iron soil pipe and fittings in accordance with the recommendations of the Cast Iron Soil Pipe's Institute's (CISPI) Cast Iron Soil Pipe and Fittings Handbook.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Combination clevis hanger, pipe insulation shield and vapor barrier jacketed high density insulating saddle with companion high density filler piece.
 - 1. Insulating saddles and filler pieces shall be of the same thickness and materials as the adjoining pipe insulation. Saddles shall cover the lower 180 degrees of the pipe or tubing, and companion filler pieces shall cover the upper 180 degrees of the pipe or tubing. Physical sizes, gages, etc. of the components of insulated hangers shall be in accordance with the following schedule:

PIPE OR TUBING SIZE (Inches)	SHIELD LENGTH (Inches)	SHIELD GAUGE	SADDLE LENGTH (Inches)	VAPOR BARRIER JACKET LENGTH (Inches)
Up to 2-1/2	4	16	6	10
3 to 6	4	14	6	10
8 to 14	10	12	12	16
16 and up	10	10	12	16

- B. Pipe Insulation Shields: Fabricated of steel, with a minimum arc of 180 degrees, unless otherwise indicated. Shields for use with hangers and supports, with the exception of combination clevis type hangers, shall be in accordance with the following schedule:

PIPE OR TUBING SIZE (Inches)	SHIELD LENGTH (Inches)	SHIELD GAUGE
Up to 2-1/2	8	18
3 to 8	10	16
10 to 14	12	12
16 and up	18	10

- C. Pipe Hangers: Height adjustable standard duty clevis type, with cross bolt and nut.
1. Pipe spreaders or spacers shall be used on cross bolts of clevis hangers, when supporting piping ten (10) inches in size and larger.
 2. Swivel ring type hangers will be allowed for sprinkler piping up to a maximum of two (2) inches in size.
- D. Adjustable Floor Rests and Base Flanges: Steel.
- E. Hanger Rods: Mild, low carbon steel, fully threaded or threaded at each end, with two (2) nuts at each end for positioning rod and hanger, and locking each in place.
- F. Riser Clamps: Malleable iron or steel.
- G. Rollers: Cast Iron.
- H. Specialty: Fasteners, supports and hangers for PEX piping shall be specifically designed for PEX piping.

2.2 ANCHORS AND ATTACHMENTS

- A. Sleeve Anchors (Group II, Type 3, Class 3): Molly's Div./USM Corp. Parasleeve Series, Ramset's Dynabolt Series, or Red Head/Phillips AN, HN, or FS Series.
- B. Wedge Anchors (Zinc Plated, Group II, Type 4, Class 1): Hilti's Kwik Bolt Series, Molly's Div./USM Corp. Parabolt PB Series, Ramset's Trubolt T Series, or Red Head/Phillips WS Series.
- C. Self-Drilling Anchors (Group III, Type 1): Ramset's RD Series, or Red Head/Phillips S Series.
- D. Non-Drilling Anchors (Group VIII, Type 1): Ramset's Dynaset DS Series, Hilti's HDI Series, or Red Head/Phillips J Series.
- E. Stud Anchors (Group VIII, Type 2): Red Head/Phillips JS Series.

- F. Beam Clamps: Forged steel beam clamp, with weldless eye nut (right hand thread), steel tie rod, nuts, and washers, Grinnell's Fig No. 292 (size for load, beam flange width, and rod size required).
- G. Metal Deck Ceiling Bolts: B-Line Systems' Fig. B3019.

2.3 FASTENERS

- A. Bolts, Nuts, Washers, Lags, and Screws: Medium carbon steel; size and type to suit application; galvanized for high humidity locations, and treated wood; plain finish for other interior locations. Except where shown otherwise on the Drawings, furnish type, size, and grade required for proper installation of the Work.

2.4 SHOP PAINTING AND PLATING

- A. Hangers, supports, rods, inserts and accessories used for pipe supports, unless chromium plated, cadmium plated or galvanized shall be shop coated with metal primer paint. Electroplated copper hanger rods, hangers and accessories shall be used when hangers are in direct contact with copper pipe or copper tubing.
- B. Hanger supports for chromium plated pipe shall be chromium plated brass.

2.5 ROOFTOP SUPPORT SYSTEMS

- A. Rooftop supports for piping equipment shall be provided for installation without requiring roof penetrations, flashing, or damage to the roofing material. Height-adjustable supports may be used where necessary. Support piping a minimum of 4" above the roof surface.
- B. Materials:
 - 1. Support bases shall be made of an engineered material with appropriate additives for UV protection. All structural steel components shall be hot-dipped galvanized.
 - 2. The support shall have a continuous bottom surface to provide even load distribution and minimize point loading of the roof membrane. The support base will have a radiused edge to enhance compatibility with roof membranes.
 - 3. Coordinate static load rating of the support(s) with the specific application being served.
 - 4. Accessories: Clamps, bolts, nuts, washers, and other devices as required for a complete system.
- C. Applications:
 - 1. Fixed Strut Pipe Hanger Supports: Size and load ratings for the application
 - 2. Adjustable Strut Pipe Hanger Supports: Height adjustable, size and load ratings for the application
 - 3. Adjustable Single Piping Supports: Height adjustable, size and load ratings for the application
 - 4. Block Supports: Size and load ratings for the application

5. Roller Supports: Height adjustable, size and load ratings for the application
 6. Bridge Assemblies:
 - a. Suitable for multiple piping runs or equipment
 - b. Size and load ratings for the application
 7. Post Base Assemblies:
 - a. For use with vertical sections of channel support systems
 - b. Size, channel support configuration, and load ratings for the application
- D. Acceptable Manufacturers:
1. Caddy/Pentair
 2. Cooper B-Line
 3. Mifab, Arlington
 4. Rooftop Blox
 5. Haydon
 6. MAPA Products
 7. Miro Industries

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Do not hang or support one (1) pipe from another or from ductwork.
- B. Do not bend threaded rod.
- C. Do not hang or support equipment from the bottom chord of joists.
- D. Support all insulated horizontal piping conveying fluids below ambient temperature, by means of hangers or supports with insulation shields installed outside of the insulation.
- E. Space hangers or supports for horizontal piping on maximum center distances as listed in the documents, and as follows.
 1. Cast Iron Soil Pipe:
 - a. General:
 - 1) Where piping is suspended on centers in excess of 18 inches by means of non-rigid hangers, provide sway bracing to prevent horizontal pipe movement.
 - 2) Additionally, brace piping five (5) inches and larger to prevent horizontal movement and/or joint separation. Provide braces, blocks, rodding or other suitable method at each branch opening, or change of direction
 - b. For Bell & Spigot Cast Iron Soil Pipe: Space hangers or support pipe at each joint or on maximum centers of five (5) feet. Place hangers or supports as close as

possible to joints and when hangers or supports do not come within one (1) foot of a branch line fitting, install an additional hanger or support at the fitting.

- c. For Hubless Cast Iron Soil Pipe: Space hangers or support pipe at each joint or on maximum centers of five (5) feet. Place hanger or supports as close as possible to joints and when hangers or supports do not come within one (1) foot of a branch line fitting, install an additional hanger or support at the fitting.
2. For Directional Changes: Install a hanger or support close to the point of change of direction of all pipe runs in either a horizontal or vertical plane.
3. For Concentrated Loads: Install additional hangers or supports, spaced as required and directed, at locations where concentrated loads such as in-line pumps, valves, fittings or accessories occur, to support the concentrated loads.
4. For Branch Piping Runs and Runouts Over 5 feet In Length: Install a minimum of one hanger, and additional hangers if required by the hanger spacing schedules.
5. Parallel Piping Runs: Where several pipe lines run parallel in the same plane and in close proximity to each other, trapeze hangers may be used. Base hanger spacing for trapeze type hangers on the smallest size of pipe being supported. Design the entire hanger assembly based on a safety factor of five, for the ultimate strength of the material being used.

F. Size hanger rods in accordance with the following

PIPE SIZE (Inches)	SINGLE ROD HANGER SIZE (Inches)		DOUBLE ROD HANGER SIZE (Inches)	
	PIPE	TUBING	PIPE	TUBING
1/2 to 2	3/8	1/4	3/8	1/4
2-1/2 and 3	1/2	3/8	3/8	1/4
4 and 5	5/8	1/2	1/2	3/8
6	3/4	1/2	5/8	1/2
8, 10 and 12	7/8	5/8	3/4	5/8

1. Secure hanger rods as follows: Install one (1) nut under clevis, angle or steel member; one (1) nut on top of clevis, angle or steel member; one (1) nut inside insert or on top of upper hanger attachment and one (1) nut and washer against insert or on lower side of upper hanger attachment. A total of four (4) nuts are required for each rod, two (2) at upper hanger attachment and two (2) at hanger.
2. Size hanger rods, for piping over 12 inches in size and multiple line supports, based on a safety factor of five for the ultimate strength of the materials being used.

G. Vertical Piping

1. Support vertical risers of piping systems, by means of heavy duty hangers installed close to base of pipe risers, and by riser clamps with extension arms at intermediate floors, with the distance between clamps not to exceed 25 feet, unless otherwise specified. Support pipe risers in vertical shafts equivalent to the aforementioned. Install riser clamps above floor slabs, with the extension arms resting on floor slabs. Provide adequate clearances for risers that are subject to appreciable expansion and contraction, caused by operating temperature ranges.

2. Support extension arms of riser clamps, secured to risers to be insulated for cold service, 4 inches above floor slabs, to allow room for insulating and vapor sealing around riser clamps.
 3. Support cast iron risers, by means of heavy duty hangers installed close to the base of the pipe risers, and 1/4 inch thick malleable iron or steel riser clamps with extension arms at each floor level, with the distance between clamps not to exceed 25 feet. Support cast iron risers in vertical shafts equivalent to the aforementioned.
 4. Support hubless cast iron risers, by means of heavy duty hangers installed close to the base of the pipe risers, and by malleable iron or steel riser clamps with the extension arms at each floor level, with the distance between clamps or intermediate supports not to exceed 12 feet. Support risers in vertical shafts equivalent to the aforementioned.
- H. Floor Supports: Install adjustable yoke rests with base flanges, for the support of piping, unless otherwise indicated on the Drawings. Install supports in a manner, which will not be detrimental to the building structure.
- I. Underground Cast Iron Pipe Supports: Firmly bed pipe laid underground, on solid ground along bottom of pipe. Install masonry piers for pipe laid in disturbed or excavated soil or where suitable bearing cannot be obtained. Support pipe, laid proximate to building walls in disturbed or excavated soil, or where suitable bearing cannot be obtained, by means of wall brackets or hold-fasts secured to walls in an approved manner.

3.2 UPPER HANGER ATTACHMENTS

- A. General
1. Secure upper hanger attachments to overhead structural steel, steel bar joists, or other suitable structural members.
 2. Do not attach hangers to steel decks that are not to receive concrete fill.
 3. Do not attach hangers to precast concrete plank decks less than 2-3/4 inches thick.
 4. Do not use flat bars or bent rods as upper hanger attachments.
- B. Attachment to Steel Frame Construction: Provide intermediate structural steel members where required by pipe support spacing. Select steel members for use as intermediate supports based on a minimum safety factor of five.
1. Do not use drive-on beam clamps.
 2. Do not support piping over 4 inches in size from steel bar joists. Secure upper hanger attachments to steel bar joists at panel points of joists.
 3. Do not drill holes in main structural steel members.
 4. Beam clamps, with tie rods as specified, may be used as upper hanger attachments for the support of piping, subject to clamp manufacturer's recommended limits.
- C. Attachment to Concrete Filled Steel Decks
1. New Construction: Install metal deck ceiling bolts.

2. Existing Construction: Install welding studs (except at roof decks). Do not support a load in excess of 250 lbs from any single welded stud.
3. Do not attach hangers to decks less than 2-1/2 inches thick.

D. Attachment to Hollow Block or Hollow Tile Filled Concrete Decks

1. New Construction: Omit block or tile and pour solid concrete with cast-in-place inserts.
2. Existing Construction: Break out block or tile to access, and install machine bolt anchors at highest practical point on side of web.

E. Attachment to Wood Construction: Secure hangers to the sides (only) of wood members, by means of malleable iron side beam connectors, or malleable iron or steel side beam brackets. Do not secure hanger attachments to nailing strips resting on top of steel beams.

1. Secure side beam connectors to wood members with two (2) No.18 x 1-1/2 inch long wood screws, or two (2) No.16 x 1-1/2 inch long drive screws. Do not support piping over 1-1/2 inches in size from side beam connectors. Do not hammer in wood screws.
2. Secure side beam brackets to wood members with steel bolts or lag screws. Do not use lag screws in wooden members having a nominal thickness (beam face) under two (2) inches in size. Install bolts or lag screws, in the sides of a timber or a joist, at the mid-point or above, not less than 2-1/2 inches from the lower edge when supporting branch lines and not less than three (3) inches from the lower edge when supporting mains. Install heavy gauge steel washers under all nuts.
3. Secure side beam brackets to wooden beams or joists, with lag screws or bolts of size as follows:

PIPE SIZE (Inches)	LAG SCREW SIZE (Inches)	BOLT DIAMETER (Inches)
2 and under	3/8 diameter x 1-3/4	3/8
2-1/2 and 3	1/2 diameter x 2	1/2
4 and 5	Use Bolt	5/8

- a. Do not support piping larger than 3 inches with lag screws. Pre-drill holes for lag screws 1/8 inch in diameter less than the root diameter of the lag screw thread.
- b. The minimum width of the lower face of wood beams or joints in which lag screws of size as specified may be used is as follows:

LAG SCREW DIAMETER (Inches)	NOMINAL WIDTH OF BEAM FACE (Inches)
3/8	2
1/2	3

4. Do not secure hanger attachment to the diagonals or vertical members of the trusses.

3.3 ANCHORS, RESTRAINTS, RIGID SUPPORTS, STAYS AND SWAY BRACES

- A. Install pipe anchors, restraints and sway braces, at locations noted on the Drawings. Design anchors so as to permit piping to expand and contract freely in opposite directions, away from anchor points. Install anchors independent of all hangers and supports, and in a manner that will not affect the structural integrity of the building.

B. Cast Iron Soil Piping Systems

1. Where piping is suspended on centers in excess of 18 inches by means of non-rigid hangers, provide sway braces, of design, number and location in accordance with the Cast Iron Soil Pipe Institute's Cast Iron Soil Pipe and Fittings Handbook to prevent horizontal pipe movement.
2. Additionally, brace piping five (5) inches and larger to prevent horizontal movement and/or joint separation. Provide braces, blocks, rodding or other suitable method at each branch opening, or change of direction in accordance with the Cast Iron Soil Pipe Institute's Cast Iron Soil Pipe and Fittings Handbook to prevent horizontal pipe movement.

3.4 COMBINATION CLEVIS HANGER, PIPE INSULATION SHIELD AND VAPOR BARRIER JACKETED HIGH DENSITY INSULATING SADDLES

- A. Install a combination clevis hanger, pipe insulation shield and vapor barrier jacketed high density insulating saddles, at all points of support for piping or tubing to be insulated for cold service. Furnish companion high density vapor barrier jacketed saddle pieces, of the same material, thickness and length, for installation over the top 180 degree surface of pipe or tubing, at each point of support where an insulated clevis hanger is utilized.

3.5 PIPE INSULATION SHIELDS

- A. Unless otherwise specified, install a pipe insulation shield, at all points of support. Center shields on all hangers and supports outside of high density insulation insert, and install in such a manner so as not to cut, or puncture jacket.

3.6 ROOFTOP SUPPORT SYSTEM

- A. Install in accordance with manufacturer's instructions and recommendations.
- B. Provide complete and adequate support of all piping and equipment.
- C. The use of wood blocks for supporting piping or equipment is not permitted.
- D. If gravel top roof, gravel must be removed around and under support.
- E. Consult roofing manufacturer for roof membrane compression capacities. If necessary, a compatible sheet of roofing material (isolation pad) may be installed under rooftop support to disperse concentrated loads and add further membrane protection.
- F. Use properly sized clamps to secure piping or equipment.

END OF SECTION

SECTION 23 0553 - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the following Equipment Identification indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Items to be labeled
 - 1. Plumbing and Piping Valves
 - 2. Piping
 - 3. Equipment (Including but not limited to the following)
 - a. Air Handling Units (RTU, Makeup Air Units)
 - b. Fans
 - c. Terminal Devices (Cabinet Heater, Unit Heater)
 - d. Pumps
 - 4. Thermostats

1.2 REFERENCES

- A. ANSI A13.1 - Scheme for Identification of Piping Systems.

1.3 SUBMITTALS

- A. Product Data
 - 1. Manufacturer's catalog sheets and specifications for mechanical identification materials.
 - 2. Installation instructions.
 - 3. Schedule indicating what type of materials will be used for various equipment, valves, piping, and devices.

PART 2 - PRODUCTS

2.1 EQUIPMENT TAGS

- A. Aluminum Nameplates: Black enamel background with natural aluminum border and engraved letters furnished with two mounting holes and screws.
- B. Plastic Tags: 1/16" thick, UV resistant phenolic plastic. Minimum 1-1/2" square or round laminated with engraved, 1/4" minimum black letters on light contrasting background.
- C. Tags shall be black with white lettering.

- D. Lettering: Lettering shall be supplier's normal font, minimum 1" high

2.2 VALVE TAGS

- A. Brass Tags: 1-1/2" Round 19 gauge brass tags with 1/4" minimum engraved letters.
- B. Plastic Tags: 1/16" thick, UV resistant phenolic plastic. 1-1/2" round laminated with engraved, 1/4" minimum black letters on light contrasting background.
- C. Tags shall be brass or white with solid black lettering.
- D. Provide with brass ball chain or plastic zip connectors to attach tag to valve

2.3 PIPE MARKERS AND ACCESSORIES

- A. Snap-on Marker: One (1) piece wrap around type constructed of pre-coiled acrylic plastic with clear polyester coating, integral flow arrows, legend printed in alternating directions, 3/4 inch adhesive strip on inside edge, and 360 degree visibility.
- B. Strap-On Marker: Strip type constructed of pre-coiled acrylic plastic with clear polyester coating, integral flow arrows, legend printed in alternating directions, factory applied grommets, and pair of stainless steel spring fasteners.
- C. Stick-On Marker: Pressure sensitive adhesive backed type constructed of vinyl with clear polyester coating, and integral flow arrows for applications where flow arrow banding tape is not being used.
- D. Underground Marker: 6" wide, thickness depends on type. Provide detectable type for non-metallic piping such as plastic gas, water main, or underground PVC piping.
- E. Pipe Marker Legend and Color Field Sizes:

OUTSIDE DIAMETER OF PIPE OR INSULATION (Inches)	LETTER SIZE (Inches)	LENGTH OF COLOR FIELD (Inches)
3/4 to 1-1/4	1/2	8
1-1/2 to 2	3/4	8
2-1/2 to 6	1-1/4	12
8 to 10	2-1/2	24
Over 10	3-1/2	32

- F. Banding Tapes: Pressure sensitive adhesive backed type constructed of vinyl with clear polyester coating.
1. Plain Tape: Unprinted type; color to match pipe marker background.
 2. Flow Arrow Tape: Printed type with integral flow arrows; color to match pipe marker background.
- G. Pipe Size Labels: Pressure sensitive adhesive backed type constructed of vinyl with clear polyester coating, vertical reading pipe size in inches, and legend size matching adjacent pipe marker.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Complete testing, insulation and finish painting work prior to completing the Work of this Section.
- B. Clean pipe surfaces with cleaning solvents prior to installing piping identification.
- C. Remove dust from insulation surfaces with clean cloths prior to installing piping identification.

3.2 PIPING IDENTIFICATION

- A. Install the Work of this Section in accordance with the manufacturer's printed installation instructions, unless otherwise specified.
- B. Stick-On Pipe Markers:
 - 1. Install minimum of two (2) markers at each specified location, 90 degrees apart on visible side of pipe.
 - 2. Encircle ends of pipe markers around pipe or insulation with banding tape with one inch lap. Use plain banding tape on markers with integral flow arrows, and flow arrow banding tape on markers without integral flow arrows.
- C. Pipe Size Labels: Install labels adjacent to each pipe marker and upstream from flow arrow. Install a minimum of two (2) pipe size labels at each specified location, 90 degrees apart on visible side of pipe.
- D. Underground Pipe Markers: Install 8-12" above buried piping. Install along entire length of pipe.

3.3 PIPING IDENTIFICATION SCHEDULE

- A. Piping Identification Types

Piping:	Field Color:	Lettering Color:
Domestic Water	Green	White
Sanitary, Vent, Condensate, Drain	Green	White
Natural Gas	Yellow	Black

- B. Locate piping identification as follows:
 - 1. Locate piping identification at valve locations; at points where piping enters and leaves a partition, wall, floor or ceiling, and at intervals of 20 feet on straight runs.
 - 2. Where two (2) or more pipes run in parallel, place printed legend and other markers in same relative location.

3.4 EQUIPMENT IDENTIFICATION

- A. Install engraved tags on equipment using metal rivets or stainless steel sheet metal screws with a pan head. For indoor equipment, industrial strength double-sided tape is acceptable if rivets or screws cannot be used. Install label on most visible side of equipment. Place identification along center line of equipment, if possible.
- B. Label all mechanical equipment using the same callout as used on the drawings, by means of engraved tags.
- C. Do not label equipment in exposed public spaces, e.g. cabinet unit heaters, diffusers, louvers, etc.
- D. Label thermostats with the corresponding equipment served.

3.5 VALVE TAGS

- A. Valve tags shall be engraved with the following information:
 - 1. Service Abbreviation
 - 2. Valve number
- B. Service Abbreviation shall match piping nomenclature used on Drawings.
- C. Attach tags to valves, not valve handles or wheels.
- D. Trim excess from connecting strip or chain.
- E. Valve Schedule
 - 1. Provide a valve schedule that lists all valves not installed for individual plumbing fixtures. Valve schedule shall list the following information in order: service, tag number, size, usage (shut-off, balancing, control, etc.), name and number or room location, normally open or closed, pressure rating, manufacturer, model number, and installation date.
 - 2. Provide three (3) laminated hard copies and one (1) electronic copy in .pdf format. Hard copies shall be clearly legible and a minimum of 11" x 17".
 - 3. Mount one (1) of the hard copies in a solid metal frame in a location designated by the Owner.

3.6 SPECIAL CONDITIONS

- A. Additional labels shall be installed at the request of the Engineer/Owner.

END OF SECTION

SECTION 23 0593 - CLEANING AND TESTING

PART 1 - GENERAL

1.1 SCOPE

- A. Cleaning of systems to remove construction debris and prepare for testing and operation.
- B. Perform testing on systems and equipment to confirm they can withstand normal operating and design conditions as outlined in various equipment sections.
- C. Equipment Included in This Section
 - 1. Natural gas piping
 - 2. Domestic water piping

1.2 REFERENCES

- A. Balancing of Systems: Section 230594.

1.3 SUBMITTALS

- A. Quality Control Submittals
 - 1. Submit Field Test Reports for all systems to be tested.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements
 - 1. Perform factory testing of factory fabricated equipment in complete accordance with the agencies having jurisdiction.
 - 2. Perform field testing of piping systems in complete accordance with the local utilities and other agencies having jurisdiction and as specified.

1.5 PROJECT CONDITIONS

- A. Protection: During test Work, protect controls, gages and accessories which are not designed to withstand test pressures. Do not utilize permanently installed gauges for field testing of systems.

1.6 SEQUENCING AND SCHEDULING

- A. Transmit written notification of proposed date and time of operational tests to the Architect / Engineer at least five (5) days in advance of such tests.
- B. Perform cleaning and testing Work in the presence of the Owner's Representative.

- C. Pressure test piping systems inside buildings, at the roughing-in stage of installation, before piping is enclosed by construction Work, and at other times as directed. Perform test operations in sections as required and directed, to progress the Work in a satisfactory manner and not delay the general construction of the building. Valve or cap-off sections of piping to be tested, utilizing valves required to be installed in the permanent piping systems or temporary valves or caps as required to perform the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Test Equipment and Instruments: Type and kind as required for the particular system under test.
- B. Test Media (air, gas, refrigerant, dry nitrogen, vacuum, water): As specified for the particular piping or system under test.
- C. Cleaning Agent (chemical solution, steam, water): As specified for the particular piping, apparatus or system being cleaned.

PART 3 - EXECUTIONPRELIMINARY WORK

- A. Thoroughly clean pipe and tubing prior to installation. During installation, prevent foreign matter from entering systems. Prevent if possible and remove stoppages or obstructions from piping and systems.

3.2 PRESSURE TESTING OF PIPING

- A. Piping shall be tight under test and shall not show loss in pressure or visible leaks, during test operations or after the minimum duration of time as specified. Remove piping which is not tight under test; remake joints and repeat test until no leaks occur.
- B. Water Systems
 - 1. Domestic water (potable cold, domestic hot and recirculation) inside buildings:
 - a. Before fixtures, faucets, trim and accessories are connected, perform hydrostatic test at 125 psig minimum for four (4) hours.
 - b. After fixtures, faucets, trim and accessories are connected, perform hydrostatic retest at 75 psig for four (4) hours.
- C. Gas Piping: Before backfilling or concealment perform air test of duration and pressure as required by the local gas company. However, for gas piping designed for pressures of from 4 inches to 6 inches water column, air test at 15 inches Hg for one (1) hour, without drop in pressure. Test gas piping with air only. Check joints for leaks with soap suds.

3.3 TESTING OF EQUIPMENT, APPARATUS AND APPURTENANCES

- A. Relief Valves: Increase pressure in equipment or apparatus to relief valve setting, to test opening of valves at required relief pressures.

3.4 DISINFECTION OF POTABLE WATER SYSTEMS

- A. Disinfect potable water pipe and equipment installed in the Work of this Contract.
 - 1. Completely fill the piping, including water storage equipment if installed, with a water solution containing 50 mg/L available chlorine, and allow stand for twenty-four (24) hours.
 - 2. Operate all valves during this period to assure their proper disinfection.
 - 3. After the retention period, discharge the solution to an approved waste and flush the system thoroughly with water until substantially all traces of chlorine are removed.
 - 4. Drain and flush water storage equipment if installed.
- B. Connect plumbing fixtures and equipment and place the system into service. Prevent recontamination of the piping during this phase of the Work.

END OF SECTION

SECTION 23 0594 – TESTING ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required for complete Testing, Adjusting and Balancing of the systems as indicated by the Contract Documents with supplementary items necessary for proper system operation.
- B. Equipment included in This Section
 - 1. Air Handling Equipment
 - a. Rooftop air handling units
 - b. Makeup air handling units
 - c. Exhaust fans
 - d. Air inlets and outlets
 - 2. Plumbing Equipment
 - a. Hot water circulation pump
 - b. Hot water circulation branch balancing valves

1.2 SUBMITTALS

- A. Certified TAB reports

1.3 QUALITY ASSURANCES

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB, or TABB.
 - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB, or TABB.
 - 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB, or TABB as a TAB technician.

1.4 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.5 PROJECT CONDITION

- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations

1.6 COORDINATION

- A. Notice: Provide seven (7) days advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.7 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent
 - 2. Air Outlets and Inlets: Plus or minus 10 percent

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

- A. Subject to compliance with requirements, engage one (1) of the following
 - 1. Precision Facility Solutions
 - 2. System Management and Balance
 - 3. System Works

3.2 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

- E. Examine ceiling plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Metal Ductwork" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design". Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- L. Examine system pumps to ensure absence of entrained air in the suction piping.
- M. Examine operating safety interlocks and controls on HVAC equipment.
- N. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Automatic temperature-control systems are operational.
 - 3. Equipment and duct access doors are securely closed.
 - 4. Balancing dampers are open.
 - 5. Isolating and balancing valves are open and control valves are operational.

6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
7. Windows and doors can be closed so indicated conditions for system operations can be met.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in this specification and one of the following:
 1. AABC's "National Standards for Total System Balance"
 2. ASHRAE 111
 3. NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems"
 4. SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing"
- B. Comply with requirements of the adopted version of ASHRAE 62.1, Section on balancing.
- C. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation".
- D. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- E. Take and report testing and balancing measurements in inch-pound (IP).

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- C. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- D. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- E. Verify that motor starters are equipped with properly sized thermal protection.
- F. Check dampers for proper position to achieve desired airflow path.

- G. Check for airflow blockages.
- H. Check condensate drains for proper connections and functioning.
- I. Check for proper sealing of air-handling-unit components.
- J. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ductwork."

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - 2. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow
 - 3. Measure fan static pressures as follows to determine actual static pressure:
 - 4. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - 5. Measure static pressure a few feet downstream of a fan or in a location that will avoid turbulent or unrepeatable performance.
 - 6. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - 7. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 8. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - 9. Report the cleanliness status of filters and the time static pressures are measured.
 - 10. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 - 11. Balancer can adjust fan speeds 15% higher or lower than speed indicated in the approved shop drawing to meet the required capacity. If a fan needs to operate outside these parameters to meet the capacity requirements, balancer to contact the Engineer for approval. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance
 - 12. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

- B. Adjust volume dampers for main duct, sub-main ducts, and major branch ducts to indicated airflows within specified tolerances.
 - 1. Measure airflow of sub-main and branch ducts.
 - 2. Where sufficient space in sub-main and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 - 3. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 - 4. Re-measure each sub-main and branch duct after all have been adjusted. Continue to adjust sub-main and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
 - 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
 - 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 - 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer's name, model number, and serial number.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.8 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each electric heating coil:
 - 1. Nameplate data
 - 2. Airflow
 - 3. Entering- and leaving-air temperature at full load
 - 4. Voltage and amperage input of each phase at full load and at each incremental stage
 - 5. Calculated kilowatt at full load
 - 6. Fuse or circuit-breaker rating for overload protection
- B. Measure, adjust, and record the following data for each refrigerant coil:
 - 1. Dry-bulb temperature of entering and leaving air
 - 2. Wet-bulb temperature of entering and leaving air
 - 3. Airflow
 - 4. Air pressure drop

3.9 FINAL REPORT

- A. General: Prepare a certified written report;
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Pump curves
 - 2. Fan curves
 - 3. Manufacturers' test data
 - 4. Field test reports prepared by system and equipment installers
 - 5. Other information relative to equipment performance; do not include Shop Drawings and product data
- C. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page
 - 2. Name and address of the TAB contractor

3. Project name
 4. Project location
 5. Architect's name and address
 6. Engineer's name and address
 7. Contractor's name and address
 8. Report date
 9. Signature of TAB supervisor who certifies the report
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 - d. Nomenclature sheets for each item of equipment.
 - e. Data for terminal units, including manufacturer's name, type, size, and fittings.
 - f. Notes to explain why certain final data in the body of reports vary from indicated values.
 12. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Settings for supply-air, static-pressure controller.
 - g. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Duct, outlet, and inlet sizes.
 3. Pipe and valve sizes and locations.
 4. Balancing stations.
 5. Position of balancing devices.

3.10 INSPECTIONS

- A. Initial Inspection

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
 - a. Measure airflow of at least ten (10) percent of air outlets.
 - b. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - c. Verify that balancing devices are marked with final balance position.
 - d. Note deviations from the Contract Documents in the final report.

B. Final Inspection

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by the Owner's Representative.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Owner's Representative.
3. Owner's Representative shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal eight (8)-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than ten (10) percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.11 ADDITIONAL TESTS

- A. Within ninety (90) days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 0713 - DUCTWORK INSULATION

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the following Ductwork Insulation indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Equipment Included in This Section
 - 1. Insulation
 - 2. Fasteners
 - 3. Jacketing
 - 4. Sealants

1.2 REFERENCES

- A. Ductwork schedules located on Drawings.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed in the following references:
 - 1. NFPA 90
 - 2. ASTM
- C. Abbreviations
 - 1. K: Thermal Conductivity, in Btu per inch thickness per hour per square foot.
 - 2. PVC: Polyvinylchloride

1.3 SUBMITTALS

- A. Product Data
 - 1. Manufacturer's catalog sheets and specifications for insulation materials and jacket materials.
 - 2. Materials Schedule: Itemize insulation materials and thicknesses for each specified application in Insulation Material Schedules in Part 3 of this Section. Where optional materials are specified, indicate option selected. Schedule should be similar to Ductwork schedule on Drawings.

1.4 QUALITY ASSURANCE

- A. Qualifications: The persons installing the Work of this Section and their Supervisor shall be personally experienced in mechanical insulation work and shall have been regularly employed by a company installing mechanical insulation for a minimum of five (5) years.
- B. Regulatory Requirements
 - 1. Insulation installed inside buildings, including duct lining materials, laminated jackets, mastics, sealants and adhesives shall have a Fire Spread/Smoke Developed Rating of 25/50 or less based on ASTM E 84.

PART 2 - PRODUCTS

2.1 ADHESIVES

- A. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Calcium Silicate Adhesive: fibrous, sodium-silicate-based adhesive with a service temperature range of 50° F - 800° F (10° C - 427° C).
- C. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of -75° F to +300° F (-59° C to +149° C).
- D. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, class 2, Grade A.
- F. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- G. PVC Jacket Adhesive: Compatible with PVC jacket.

2.2 MASTICS

- A. For indoor applications, use mastics that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

2.3 LAGGING ADHESIVES

- A. For indoor applications, use adhesive that has a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

2.4 JACKETS

A. PVC Jackets

1. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness: 0.030".
2. Adhesive: As recommended by jacket material manufacturer.
3. 3. Color: [White] [Color-code jackets based on system. Color as selected by Architect].

B. Stainless Steel Jackets:

1. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
2. Type 304 or Type 316 sheet and roll stock ready for shop or field sizing. Material thickness: 0.030".
3. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and 2.5mil- thick polysurlyn.

C. Aluminum Jackets:

1. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
2. Moisture Barrier for Outdoor Applications: 3-mil thick, heat-bonded polyethylene.

D. Self-Adhesive Outdoor Jackets:

1. Self-Adhesive Outdoor Jacket: 60-mil thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with [white] [stucco-embossed] aluminum-foil facing.

2.5 BANDING

- A. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316 as required to match jacketing material; 0.015 inch thick, 3/4 inch wide with wing seals.
- B. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seals.

2.6 SEALANTS

- A. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 INSULATION

- A. Ductwork Insulation Types
 - 1. Type A: Flexible fiberglass duct wrap. Minimum density 0.75 #/ft³, K of 0.30 at 75° F; ASTM C 553, Type II.
 - 2. Type B: Semi-rigid fiberglass board wrap. Minimum density 3.0 #/ft³, K of 0.23 at 75° F; ASTM C612, Type IA.
 - 3. Type C: Flexible fiberglass duct liner. Minimum density 3.0 #/ft³, K of 0.24 at 75° F; ASTM C 1071. Liner between insulation and airstream side of double-wall ductwork shall have a Fire Spread/Smoke Developed Rating of 25/50 or less based on ASTM E 84.
 - 4. Type D: Preformed rigid fiberglass duct liner. Minimum density 3.0 #/ft³, K of 0.23 at 75°F; ASTM C 1071. Liner shall have a Fire Spread/Smoke Developed Rating of 25/50 or less based on ASTM E 84
 - 5. Type E: Flexible mineral fiber duct wrap (Suitable for Temperatures Up to 1800° F). Minimum density 6 #/ft³; ASTM E 2336, NFPA 96-2011, UL 1978 (Rev. 6-02). Two (2)-hour fire separation rating with zero clearance to combustibles. Thickness shall be as specified or as required by AHJ to meet fire separation requirements.
 - 6. Type F: Flexible fiberglass duct liner for spiral ductwork. Minimum density 3.0 #/ft³, K of 0.23 at 75° F; Liner shall have a Fire Spread/Smoke Developed Rating of 25/50 or less based on ASTM E 84.
- B. Fire resistant, anti-erosion, and anti-microbial coating on lining interior to duct; NFPA 90-A and 90-B.
- C. All insulation densities listed are minimum densities. Contractor shall be responsible for verifying the required insulation thickness & density to meet the minimum installed insulation R-values as listed in the ductwork schedules on the drawings.

PART 3 - EXECUTION

3.1 DUCT INSULATION SCHEDULE

- A. Refer to Ductwork Application Schedule on Drawings for insulation requirements.

3.2 PREPARATION

- A. Perform the following before starting insulation work.
 - 1. Install hangers, supports and appurtenances in their permanent locations.
 - 2. Complete testing of piping, ductwork, and equipment.

3. Clean and dry surfaces to be insulated.

3.3 INSTALLATION, GENERAL

- A. Install the work of this section in accordance with the manufacturer's printed installation instructions unless otherwise specified.

3.4 INSTALLATION AT HANGERS AND SUPPORTS

- A. Reset and realign hangers and supports if they are displaced while installing insulation.
- B. Insulation inserts for use with fibrous glass insulation:
 1. Ductwork: Install 6 #/ft³ density jacketed fibrous glass board, same thickness as adjoining insulation, sized for full bearing on supporting trapeze member, and as required to enable abutting to adjoining insulation and overlapping of jacketing.

3.5 INSTALLATION OF DUCTWORK INSULATION

- A. Exterior to Ductwork
 1. Cut insulation to stretch-out dimensions as recommended by insulation manufacturer.
 2. Remove two (2) inch wide strip of insulation material from the jacketing on the longitudinal and circumferential joint edges to form an overlapping staple/tape flap.
 3. Install insulation with jacketing outside so staple/tape flap overlaps insulation and jacketing on other end.
 4. Butt ends of insulation tightly together.
 - a. Rectangular and Square Ductwork: Do not compress insulation at duct corners.
 5. Staple longitudinal and circumferential joints with outward clinching staples minimum six (6) inches on center, and seal with pressure sensitive sealing tape.
 6. Cut off protruding ends of fasteners flush with insulation surface and seal with pressure sensitive sealing tape.
 7. Install duct insulation fasteners on bottom side of horizontal duct runs, when bottom dimension of the duct is in excess of 24 inches in width.
 8. Install duct insulation fasteners on sides of duct risers having a dimension over 24 inches in size.
 9. Seal tears, punctures, and penetrations of insulation jacketing with sealing tape.
- B. Interior to Ductwork
 1. Insulate ducts prior to erection in place when ducts are required to be installed proximate to walls, ceilings, equipment or other ductwork, which will not permit adequate space for installation of insulation after ducts are installed.

2. Line interior surfaces of ducts with thermal and acoustic board insulation, when the specified application of exterior insulation is impractical.
 - a. Written permission from the Engineer must be received, prior to the substitution of lined ducts for exterior insulated ducts.
 - b. Maintain interior cross-sectional areas of ducts, as noted on drawings.

3.6 INSTALLATION OF JACKETING MATERIAL

A. PVC Jackets:

1. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
2. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

B. Metal Jackets:

1. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.7 FIELD QUALITY CONTROL

- #### **A. Field Samples:** The Director's Representative, may at his discretion, take field samples of installed insulation for the purpose of checking materials and application. Reinsulate sample cut areas.

3.8 DUCTWORK SERVICE INSULATION SCHEDULE

- #### **A. Insulate all ductwork except where otherwise specified. See Ductwork schedule on Drawings.**

B. Notes

1. Equipment: Insulate air handling equipment, not furnished with factory applied insulated jacket or internal insulation, with minimum 1-1/2 inch thick fibrous glass board with an ASTM C 1136 Type I jacket, installed and finished as specified for exposed ductwork in finished spaces.

END OF SECTION

SECTION 23 0719 - PIPING INSULATION

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the Piping Insulation indicated by the Contract Documents with supplementary items necessary for proper installation.

1.2 REFERENCES

- A. Pipe Hangers and Supports: Section 230529.
- B. Abbreviations
 - 1. K: Thermal Conductivity, i.e., maximum Btu per inch thickness per hour per square foot.
 - 2. pcf: Pounds per cubic foot.
 - 3. PVC: Polyvinylchloride.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's catalog sheets and specifications for the following:
 - 1. Insulation Materials.
 - 2. Jacket Materials.
 - 3. Sealant and Adhesive Materials.

1.4 QUALITY ASSURANCE

- A. Qualifications: The person(s) directly supervising the installation of this work in the field shall be personally experienced in mechanical insulation work and shall have been regularly employed by a company installing mechanical insulation for a minimum of five (5) years.
- B. Regulatory Requirements
 - 1. Insulation installed inside buildings, including laminated jackets, mastics, sealants and adhesives shall have a Fire Spread/Smoke Developed Rating of 25/50 or less based on ASTM E 84.
 - 2. Insulation shall meet minimum requirements ASHRAE 90.1-2007.

PART 2 - PRODUCTS

2.1 PIPING INSULATION

- A. Fibrous Glass (Mineral Fiber) Insulation: Composed principally of fibers manufactured from rock, slag, or glass, with or without binders, and asbestos free.
 - 1. Preformed Pipe Insulation: Minimum density 3 pcf; ASTM C 547
 - a. Class 1 (Suitable for Temperatures Up to 450° F): K of 0.26 at 75° F.
 - 2. Premolded Fitting Insulation: Minimum density 4.0 pcf, K of 0.26 at 75° F; ASTM C 547, Class 1.
 - 3. Insulation Inserts for PVC Fitting Jackets: Minimum density 1.5 pcf, K of 0.28 at 75° F; ASTM C 553, Type III. Suitable for temperatures up to 450° F.
- B. Flexible Elastomeric Foam Insulation
 - 1. FM tested and approved, meeting the following:
 - a. Maximum Water Vapor Transmission: 0.10 perm - inch based on ASTM E 96, Procedure A.
 - b. K of 0.27 at 75° F based on ASTM C 518 or C 177.
 - 2. Pipe Insulation: ASTM C 534, Type I.
 - 3. Polyethylene and polyolefin insulation is not acceptable.
- C. High Density Jacketed Insulation Inserts for Hangers and Supports
 - 1. For Use with Fibrous Glass Insulation:
 - a. Cold Service Piping:
 - 1) Polyurethane Foam: Minimum density 4 pcf, K of 0.13 at 75° F, minimum compressive strength of 125 psi.
 - b. Hot Service Piping:
 - 1) Calcium Silicate: Minimum density 15 pcf, K of 0.50 at 300° F; ASTM C 533.
 - 2) Perlite: Minimum density 12 pcf, K of 0.60 at 300° F; ASTM C 610.
 - 2. For Use with Flexible Elastomeric Foam Insulation: Hardwood dowels and blocks, length or thickness equal to insulation thickness, other dimensions as specified or required.
- D. Cements
 - 1. Fibrous Glass Thermal Insulating Cement: Asbestos free; ASTM C 195.
 - 2. Fibrous Glass Hydraulic Setting Thermal Insulating and Finishing Cement: ASTM C 449/C 449M.

2.2 INSULATION JACKETS

- A. Laminated Vapor Barrier Jackets for Piping: Factory applied by insulation manufacturer, conforming to ASTM C 1136, Type I.

1. Type I: Reinforced white kraft and aluminum foil laminate with kraft facing out.
 - a. Pipe Jackets: Furnished with integral 1-1/2" self sealing longitudinal lap, and separate 3" wide adhesive backed butt strips.
 2. Laminated vapor barrier jackets are not required for flexible elastomeric foam insulation.
- B. Canvas Jackets: Cotton duck, fire retardant, NFPA 701 compliant, 4 or 6 oz. per square yard as specified.
- C. PVC Jackets and Premolded Fitting Covers
1. Constructed of high impact, UV resistant PVC. 0.020" 0.030" thickness.
 - a. ASTM D 1784, Class 14253-C.
 - b. Working Temperature: 0-150° F.
- D. Insulated Safety Wrap: Handi Lav-Guard by Truebro Inc., or Prior Approved Equal.
1. Construction: 1/8" thick chemical resistant vinyl with internal ribs.
 2. Fasteners: Nylon tie laces or reuseable clips.
 3. Kit includes covering for 8" tailpiece, P trap, 8" waste arm, hot and cold lines and valves, and required fasteners.

2.3 ADHESIVES, MASTICS, AND SEALERS

- A. Adhesives
1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D(EPA Method 24).
 2. Calcium silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 - 800° F (10 - 427° C).
 3. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive with a service temperature range of -75°F to +300°F (-59°C to +149°C)
 4. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 5. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 6. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 7. PVC Jacket Adhesive: Compatible with PVC jacket.
- B. Mastics
1. For indoor applications, use mastics that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D(EPA Method 24).
 2. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

C. Lagging Adhesives

1. For indoor applications, use adhesive that has a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D(EPA Method 24).
2. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

D. Sealants

1. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D(EPA Method 24).
2. Vapor Seal Adhesive (Fibrous Glass Insulation): Childers' CP-82, Epolux's Cadoprene 400, Foster's 85-75 or 85-20.
3. Vapor Barrier Mastic/Joint Sealer (Fibrous Glass Insulation): Childers' CP-30, Epolux's Cadalar 670, Foster's 95-44 or 30-35.
4. Adhesive (Flexible Elastomeric Foam): Armstrong's 520, Childers' CP-80, Epolux's Cadoprene 488, Foster's 82-40.
5. Sealant (Metal Pipe Jacket): One-part silicone sealant for high temperatures; Dow Corning's Silastic 736 RTV or General Electric's RTV 106.

2.4 MISCELLANEOUS MATERIALS

A. Pressure Sensitive Tape for Sealing Laminated Jackets:

1. Acceptable Manufacturers:
 - a. Alpha Associates
 - b. Childers
 - c. Ideal Tape
 - d. Morgan Adhesive
2. Type: Same construction as jacket.

B. Wire, Bands, and Wire Mesh:

1. Binding and Lacing Wire: Nickel copper alloy or copper clad steel, gauge as specified.
2. Bands: Galvanized steel, 1/2" wide x 0.015" thick, with 0.032" thick galvanized wing seals.
3. Wire Mesh: Woven 20-gauge steel wire with 1" hexagonal openings, galvanized after weaving.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform the following before starting insulation Work:

1. Install hangers, supports and appurtenances in their permanent locations.

2. Complete testing of piping.
3. Clean and dry surfaces to be insulated.

3.2 INSTALLATION, GENERAL

- A. Install the Work of this Section in accordance with the manufacturer's printed installation instructions unless otherwise specified.
- B. Provide continuous piping insulation and jacketing when passing thru interior wall, floor, and ceiling construction.
 1. At Through Penetration Firestops: Coordinate insulation densities with the requirements of approved firestop system being installed. See Section 078400.
 - a. Insulation densities required by approved firestop system may vary with the densities specified in this Section. When this occurs use the higher density insulation.
- C. Do not intermix different insulation materials on individual runs of piping.

3.3 INSTALLATION AT HANGERS AND SUPPORTS

- A. Reset and realign hangers and supports if they are displaced while installing insulation.
- B. Install high density jacketed insulation inserts at hangers and supports for insulated piping.
- C. Insulation Inserts For Use with Fibrous Glass Insulation
 1. Where clevis hangers are used, install insulation shields and high density jacketed insulation inserts between shield and pipe.
 - a. Where insulation is subject to compression at points over 180° apart, e.g. riser clamps, U-bolts, trapezes, etc.; fully encircle pipe with two (2) protection shields and two (2) high density jacketed fibrous glass insulation inserts within supporting members.
- D. Insulation Inserts For Use with Flexible Elastomeric Foam Insulation:
 1. Where clevis hangers are used, install insulation shields with hardwood filler pieces, same thickness as adjoining insulation, inserted in undersized die cut or slotted holes in insulation at support points.
 2. Contour hardwood blocks to match the curvature of pipe, and shield.
 3. Coat dowels and blocks with insulation adhesive, and insert while still wet.
 4. Vapor seal outer surfaces of dowels and blocks with adhesive after insertion.
 5. Install filler pieces as follows:

PIPE/TUBING SIZE	FILLER PIECES	POSITION
Thru 1-1/2"	2 dowel plugs	6 o'clock; in tandem
2" thru 4"	1 block, 2 dowel plugs	6 o'clock, and 4 & 8 o'clock respectively
6" thru 8"	2 blocks, 4 dowel plugs	6 o'clock; in tandem and 4 & 8 o'clock; in tandem

3.4 INSTALLATION OF FIBROUS GLASS COLD SERVICE INSULATION

- A. Install insulation materials with a field or factory applied ASTM C 1136 Type I laminated vapor barrier jacket, unless otherwise specified.
- B. Piping
 1. Butt insulation joints together, continuously seal minimum 1-1/2" wide self-sealing longitudinal jacket laps and 3" wide butt adhesive backed strips.
 - a. Substitution: 3" wide pressure sensitive sealing tape, of same material as jacket, may be used in lieu of butt strips.
 2. Bed insulation in a 2" wide band of vapor barrier mastic, and vapor seal exposed ends of insulation with vapor barrier mastic at each butt joint between pipe insulation and equipment, fittings or flanges at the following intervals:
 - a. Horizontal Pipe Runs: 21 ft.
 - b. Vertical Pipe Runs: 9 ft.
- C. Fittings, Valves, Flanges and Irregular Surfaces
 1. Piping Systems (less than 40° F)
 - a. Insulate with mitre cut or pre-molded fitting insulation of same material and thickness as pipe insulation.
 - b. Secure insulation in place with 16-gauge wire, with ends twisted and turned down into insulation.
 - c. Butt insulation against pipe insulation and bond with joint sealer.
 - d. Insulate valves up to and including bonnets, without interfering with packing nuts.
 - e. Insulate pump impeller casings on pump systems operating below 45° F.
 - f. Apply leveling coat of insulating cement to smooth out insulation and cover wiring.
 - g. When insulating cement has dried, seal fitting, valve and flange insulation, by imbedding a layer of reinforcing membrane between two (2) flood coats of vapor barrier mastic, each 1/8" thick wet.
 - h. Lap reinforcing membrane or canvas on itself and adjoining pipe insulation at least 2 inches.
 - i. Trowel, brush or rubber glove outside coat over entire insulated surface.
 2. Piping Systems (40 - 60° F)
 - a. Valves, fittings and flanges shall be insulated with pre-molded PVC fitting jackets, with fibrous glass insulation inserts.

- 1) Additional insulation inserts are required for services with operating temperatures under 45° F or where insulation thickness exceeds 1-1/2". The surface temperature of PVC fitting jacket must not go below 45° F.

3.5 INSTALLATION OF FIBROUS GLASS HOT SERVICE INSULATION

- A. Install insulation materials with field or factory applied ASTM C 1136 Type I laminated vapor barrier jacket unless otherwise specified.
- B. Piping
 1. Butt insulation joints together, continuously seal minimum 1-1/2" wide self-sealing longitudinal jacket laps and 3" wide adhesive backed butt strips.
 - a. Substitution: 3" wide pressure sensitive sealing tape, of same material as the jacket, may be used in lieu of butt strips.
 2. Fill voids in insulation at hanger with insulating cement.
 3. Exceptions:
 - a. Piping in Accessible Shafts, Attic Spaces, Crawl Spaces, Unfinished Spaces and Concealed Piping: Butt insulation joints together and secure minimum 1-1/2" wide longitudinal jacket laps and 3" wide butt strips of same material as jacket, with outward clinching staples on maximum 4" centers. Fill voids in insulation at hangers with insulating cement.
 - b. Piping in Tunnels: Butt insulation joints together and secure minimum 1-1/2" wide longitudinal jacket laps and 3" wide butt strips, of same material as jacket, with outward clinching staples on maximum 4" centers and 16 gauge wires a minimum of four (4) loops per section. Fill voids in insulation with insulating cement.
- C. Fittings, Valves, Flanges and Irregular Surfaces
 1. Insulate with mitre cut or pre-molded fitting insulation of same material and thickness as insulation.
 2. Secure in place with 16-gauge wire, with ends twisted and turned down into insulation.
 3. Butt fitting, valve and flange insulation against pipe insulation, and fill voids with insulating cement.
 4. Insulate valves up to and including bonnets, without interfering with packing nuts.
 5. Apply leveling coat of insulating cement to smooth out insulation and cover wiring.
 6. After insulating cement has dried, coat insulated surface with lagging adhesive, and apply 4 oz or 6 oz canvas jacket as required by pipe size.
 - a. Lap canvas jacket on itself and adjoining pipe insulation at least 2".
 - b. Size entire canvas jacket with lagging adhesive.
 7. Piping Systems (below 250° F)
 - a. Valves, fittings and flanges may be insulated with pre-molded PVC fitting jackets, with fibrous glass insulation inserts.
 - 1) The surface temperature of PVC fitting jacket not to exceed 150° F.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC FOAM INSULATION

- A. Where possible, slip insulation over the pipe, and seal butt joints with adhesive.
 - 1. Where the slip-on technique is not possible, slit the insulation and install.
 - 2. Re-seal with adhesive, making sure the mating surfaces are completely joined.
- B. Insulate fittings and valves with miter cut sections. Use templates provided by the manufacturer, and assemble the cut sections in accordance with the manufacturer's printed instructions.
 - 1. Insulate threaded fittings and valves with sleeved fitting covers. Overlap and seal the covers to the adjoining pipe insulation with adhesive.
- C. Carefully mate and seal with adhesive all contact surfaces to maintain the integrity of the vapor barrier of the system.
- D. Piping Exposed Exterior to a Building, Totally Exposed to the Elements:
 - 1. Apply flexible elastomeric foam insulation to piping with adhesive.
 - 2. Apply reinforcing membrane around piping insulation with adhesive or mastic.
 - 3. Adhesive Applied System: Apply two (2) coats of finish.
 - 4. Mastic Applied System: Apply another coat of mastic over reinforcing membrane.

3.7 INSTALLATION OF PVC JACKETING ON PIPING

- A. Secure jacketing to insulated piping and seal with adhesive. All seams shall be secured flat.
- B. Jacket fittings with preformed covers.

3.8 FIELD QUALITY CONTROL

- A. Field Samples: The Owner's Representative, may at his discretion, take field samples of installed insulation for the purpose of checking materials and application. Contractor shall reinsulate sample cut areas.

3.9 PIPING INSULATION SCHEDULE

- A. Refer to Piping Application Schedule on Drawings for Piping Insulation Schedule.
- B. Insulate all cold service and hot service piping, and appurtenances except where otherwise specified.
- C. Schedule of items not to be insulated:
 - 1. Do not insulate the following items:
 - a. Actual heat transfer surfaces.
 - b. Chromium plated piping, unless otherwise specified.
 - c. Flexible vibration eliminators.

- d. Water meters.
 - e. Drains from heating equipment and appurtenances that flow to waste.
 - f. Chemical feed piping.
 - g. Piping inside convector and finned tube radiation enclosures.
 - h. Boiler blow-off and blow-down piping.
 - i. Safety and relief valves. Discharge piping from relief valves.
 - j. Vent piping to atmosphere installed exposed in Mechanical Rooms, connected to the following: Blow-off tanks, flash tanks, condensate tanks.
 - k. Flanges and unions in piping systems over 140° F.
 - l. Hydronic Specialties: Flow indicators, control valves 3" and under, air vents and air control fittings.
 - m. Steam traps and cooling legs of steam traps.
 - n. Float chambers and level controllers.
- 2. Do not insulate mechanical equipment with a factory applied insulated steel jacket, unless specified otherwise.

D. Notes:

- 1. Insulate cold condensate drain piping connected to drain pans under cooling coils within unit enclosure, except where over drain pans:

3.10 SCHEDULE OF PVC JACKETING FOR INSULATED PIPE

- A. For exposed piping, install jacketing from floor to ceiling or from floor to first change of direction in riser, when such change in direction is a minimum of 9'-0" above finished floor, whichever is applicable.
- B. Jacket exposed insulated piping in mechanical rooms with PVC jacketing.

END OF SECTION

SECTION 23 0900 – DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the following HVAC Control System indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. The control system shall consist of a high-speed, peer-to-peer network of DDC controllers and an operator workstation or web server. The system shall control or monitor all equipment specified on the Contract Drawings. See the temperature controls responsibility matrix on the drawings.
- C. Equipment Included in This Section
 - 1. Products (not furnished or installed but integrated with the Work of this section)
 - a. Coordination Meeting: The Installer furnishing the DDC network shall meet with the Installer(s) furnishing mechanical equipment, VFD's, fire alarm, and controllers to coordinate details of the interface between these products and the DDC network. The Owner or his designated representative shall be present at this meeting. Each Installer shall provide the Owner and all other Installers with details of the proposed interface hardware and software identifiers for the interface points, network identifiers, wiring requirements, communication speeds, and required network accessories. The purpose of this meeting shall be to insure there are no unresolved issues regarding the integration of these products into the DDC network. Submittals for these products shall not be approved prior to the completion of this meeting.

1.2 REFERENCES

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents.
- B. Related Work
 - 1. Section 230500 - Common Work Results for HVAC
 - 2. Section 260500 - Common Work Results for Electrical
 - 3. Section 260523 – Control Cables
 - 4. Section 232923 or 262923 – Variable Frequency Drives
 - 5. Section 280000 - Electronic Safety and Security (includes Fire and Smoke)

1.3 SUBMITTALS

- A. Product Submittal Requirements: Provide copies of Shop Drawings and other submittals on hardware, software, and equipment to be installed or furnished. Begin no work until submittals have been approved for conformity with design intent. Provide drawings in .PDF format. When

manufacturer's cutsheets apply to a product series rather than a specific product, clearly indicate applicable data by highlighting or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cutsheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve Contractor of responsibility to supply sufficient quantities to complete work.

1. Direct Digital Control System Hardware

- a. Complete bill of materials indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.
- b. Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions.
- c. Diagrams indicating field sensor and controller locations.

2. Central System Hardware and Software

- a. Complete bill of material indicating quantity, manufacturer, model number, and relevant technical data of equipment used.
- b. Manufacturer's description and technical data such as product specifications and installation and maintenance instructions.
- c. Schematic diagrams of control, communication, and power wiring for central system installation. Show interface wiring to control system.

3. Controlled Systems

- a. Riser diagrams showing control network layout, communication protocol, and wire types.
- b. Schematic diagram of each controlled system. Label control points with point names. Graphically show locations of control elements.
- c. Instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.
- d. Complete description of control system operation including sequences of operation. Include and reference schematic diagram of controlled system. List I/O points and software points specified on Drawings. Indicate alarmed and trended points.
- e. Submittal of control sequences should include the actual control sequence proposed for this project, not a copy of the sequence included in the construction documents. If the actual sequence is not available during the initial submission of the shop drawings it can be issued for review during construction prior to equipment startup.

B. Control Point Integration List

1. Contractor to provide a master list of all control points for each piece of mechanical equipment with packaged controls.

C. Control Point Verification List

1. Contractor to provide a list containing all control points after substantial completion. The list shall include the following:
 - a. Operation of the control point was operating as needed per the contract documents / shop drawings.
 - b. Who verified the point operation.
 - c. Date and time of verification.

- D. Training Materials: Provide course outline and materials for each class at least four (4) weeks before first class.
- E. Project Record Documents. Submit three (3) copies of record (as-built) documents upon completion of installation for approval prior to final completion. Submittal shall consist of:
 - 1. Provide three (3) copies of project record drawings. As-built versions of submittal shop drawings provided on a USB flash drive (file format: .PDF) and prints of each drawing on 11" x 17" paper.
 - 2. Completed versions of reports, checklists, and trend logs used to meet requirements of Control System Demonstration and Acceptance Section.
 - 3. Operation and Maintenance (O&M) Manual: Printed, electronic, or online help documentation of the following:
 - a. As-built versions of submittal product data.
 - b. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
 - c. Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.
 - d. Programming manual or set of manuals with description of programming language and syntax, statements for algorithms and calculations used, point database creation and modification, program creation and modification, and editor use.
 - e. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.
 - f. Documentation of programs created using custom programming language including setpoints, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, setpoints, tuning parameters, and objects can be viewed using furnished programming tools.
 - g. Graphic files, programs, and database on USB drive.
 - h. List of recommended spare parts with part numbers and suppliers.
 - i. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
 - j. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation or web server software, and graphics software.
 - k. Licenses, guarantees, and warranty documents for equipment and systems.
 - l. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.

1.4 QUALITY ASSURANCE

- A. Installer and Manufacturer Qualifications
 - 1. Installer shall have an established working relationship with Control System Manufacturer.
 - 2. Installer shall have successfully completed Control System Manufacturer's control system training. Upon request, Installer shall present record of completed training including course outlines.

B. Regulatory Requirements

1. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authorities' codes and ordinances or these plans and specifications.
 - a. Adopted version of the National Electric Code (NEC)
 - b. Adopted version of the International Building Code (IBC)
 - c. Adopted version of the International Mechanical Code (IMC)
 - d. ANSI/ASHRAE 135 (adopted version): Data Communication Protocol for Building Automation and Control Systems (BACNET)
 - e. Adopted version of the International Energy Conservation Code
 - f. ASHRAE 90.1 (adopted version): Energy Standard for Buildings

- C. Components shall not contain any mercury unless written permission is obtained from Owner.

1.5 WARRANTY

- A. Warrant labor and materials for specified control system free from defects for a period of twelve (12) months after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within twenty-four (24) hours of Owner's warranty service request.
- B. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period. These warranty dates shall be submitted to the Owner.
- C. Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve Contractor-identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.
- D. Exception: Contractor shall not be required to warrant reused devices except those that have been rebuilt or repaired. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of Engineer's acceptance.

1.6 OWNERSHIP OF PROPRIETARY MATERIAL

- A. Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:
1. Graphics
 2. Record drawings
 3. Database
 4. Application programming code
 5. Documentation

PART 2 - PRODUCTS

2.1 GENERAL DESCRIPTION

- A. The control system shall consist of a high-speed, peer-to-peer network of DDC controllers.
- B. Graphics shall depict each of the building systems controlled. An overall building floor plan and individual rooms shall be accessible using a point and click graphic.
- C. The system shall directly control HVAC equipment as specified on the Drawings. Each zone controller shall provide occupied and unoccupied modes of operation by individual zone. Furnish energy conservation features such as optimal start and stop, night setback, request-based logic, and demand level adjustment of setpoints as specified in the sequence.
- D. The system shall be an extension of the facilities existing system, and allow for integration of occupant card access, fire alarm, and lighting control systems to the current building HVAC equipment.
- E. Provide for future system expansion to include monitoring of occupant card access, fire alarm, and lighting control systems.

2.2 APPROVED CONTROL SYSTEMS

- A. Distech by Woodman Controls

2.3 MATERIALS

- A. Use new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five (5) years after completion of this contract.

2.4 SYSTEM PERFORMANCE

- A. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator web-based interface.
 - 1. A graphic with twenty (20) dynamic points shall display with current data within ten (10) seconds.
 - 2. A graphic with twenty (20) dynamic points shall update with current data within eight (8) seconds and shall automatically refresh every fifteen (15) seconds.
 - 3. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within six (6) seconds.
 - 4. Devices shall react to command of a binary object within two (2) seconds. Devices shall begin reacting to command of an analog object within two (2) seconds.
 - 5. An object that goes into alarm shall be annunciated at the workstation within fifteen (15) seconds.

6. Custom and standard applications shall be capable of running as often as once every five (5) seconds. Select execution times consistent with the mechanical process under control.
7. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per second. Select execution times consistent with the mechanical process under control.
8. System shall report values with minimum end-to-end accuracy listed in Table 230900-1.
9. Control loops shall maintain measured variable at setpoint within tolerances listed in Table 230900-2.

Table 230900-1: Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±1°F
Ducted Air	±1°F
Outside Air Temperature	±2°F
Dew Point Temperature	±3°F
Water Temperature	±1°F
Temperature Difference (Delta-T)	±0.25°F
Relative Humidity	±5% RH
Airflow (terminal)	±10% of full scale (Note 1)
Airflow (measuring stations)	±2% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±0.1 in. w.g.
Air Pressure (space)	±0.01 in. w.g.
Water Flow	±0.2% of full scale (Note 2) ±1.0% of full scale (Note 3)
Water Pressure	±2% of full scale (Note 4)
Electrical (A, V, W, Power Factor)	±1% of reading (Note 5)
Carbon Monoxide (CO)	±3% of reading
Carbon Dioxide (CO ₂)	±50 ppm

Notes:

1. 1 Accuracy applies to 10% - 100% of scale
2. For flanged style water flow meters.
3. For insertion style water flow meters.
4. For both absolute and differential pressure
5. Not including utility-supplied meters

Table 230900-2: Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±0.2 in. w.g. ±0.01 in. w.g.	0 to 6 in. w.g. -0.1 to 0.1 in. w.g.

Airflow	±10% of full scale	
Space Temperature	±2.0°F	
Duct Temperature	±3°F	
Relative Humidity	±5% RH	
Fluid Pressure	±1.5 psi ±1.0 in. w.g.	1 to 150 psi 0 to 50 in. w.g. differential

2.5 COMMUNICATION

- A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a unified control network. A gateway (translator) shall communicate with third-party equipment furnished or installed by others.
- B. Install new wiring and network devices as required to provide a complete and workable control network.
- C. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.
- D. System shall automatically synchronize controller time clocks daily from an operator-designated controller via the internetwork. If applicable, system shall automatically adjust for daylight saving and standard time.
- E. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.
- F. System shall support Web services data exchange with any other system that complies with XML (extensible markup language) and SOAP (simple object access protocol) standards specified by the Web Services Interoperability Organization (WS-I) Basic Profile 1.0 or higher. Web services support shall as a minimum be provided at the workstation or web server level and shall enable data to be read from or written to the system.

2.6 OPERATOR INTERFACE

- A. Web-based interface shall reside on high-speed network with building controllers. Each standard browser connected to server shall be able to access all system information.
- B. Operator interface shall allow each authorized operator to execute the following functions as a minimum:
 - 1. System shall require user name and password to log in to operator interface.
 - 2. Operator interface shall be graphically based and shall allow operators to access graphics for equipment and geographic areas using point-and-click navigation.
 - 3. Operators shall be able to:
 - a. View controlled equipment status and to adjust operating parameters such as setpoints, PID gains, on and off controls, and sensor calibration.
 - b. View scheduled operating hours of each schedulable piece of equipment on a weekly or monthly calendar-based graphical schedule display, to select and adjust

- each schedule and time period, and to simultaneously schedule related equipment. System shall clearly show exception schedules and holidays on the schedule display.
 - c. View a list of currently active system alarms, to acknowledge each alarm, and to clear (delete) unneeded alarms.
 - d. View a trend graph of each trended point and to edit graph configuration to display a specific time period or data range. Operator shall be able to create custom trend graphs to display on the same page data from multiple trended points.
 - e. Run preconfigured reports, to view report results, and to customize report configuration to show data of interest.
 - f. View controller status, to reboot each controller, and to download new control software to each controller.
 - 4. Typically, only a few operators are authorized to manage operator access. Authorized operators shall be able to view a list of operators with system access and of functions they can perform while logged in. Operators shall be able to add operators, to delete operators, and to edit operator function authorization. Operator shall be able to authorize each operator function separately.
- C. System Software
- 1. Operating System: Web server or workstation shall have an industry-standard professional-grade operating system. Acceptable systems include Microsoft Windows.
 - 2. System Graphics:
 - a. Operator interface shall be graphically based.
 - b. Each piece of equipment shall include at least one (1) graphic or occupied zone and indicate animations for fans, pumps, dampers, and compressors such that it is intuitive when they are running or when they are stopped.
 - c. Each system graphic shall include a button/tab to a display of the applicable sequence of operation.
 - d. Floorplan layouts showing rooms and temperature are required. Indicate thermal comfort on the floorplan using dynamic colors to represent zone temperature relative to zone setpoint.
 - e. By clicking on the temperature icon, this will direct you to the dedicated graphic with all related information on that piece of equipment i.e. VAV box, AHU, unit heater, etc.
 - f. When the sequence of operation state (adj.), all of these points shall be adjustable by the user from the graphics, i.e. DAT, zone temps, OA enable temps, etc.
 - g. All overridden points shall be highlighted with a unique color to clearly indicate overridden.
- D. System Tools: System shall provide the following functionality to authorized operators as an integral part of the operator interface or as stand-alone software programs. If furnished as part of the interface, the tool shall be available from each workstation or web browser interface. If furnished as a stand-alone program, software shall be installable on standard IBM-compatible PCs with no limit on the number of copies that can be installed under the system license.
- 1. Each web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.
 - 2. Operators shall be able to download memory from the system database to each controller.

3. Context-sensitive online help for each tool shall assist operators in operating and editing the system.
4. System shall require a user name and password to view, edit, add, or delete data.
 - a. Each user name and password combination shall define accessible viewing, editing, adding, and deleting functions in each system application, editor, and object.
 - b. Automatically log out each operator if no keyboard or mouse activity is detected. Operators shall be able to adjust automatic log out delay.
 - c. Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.
5. System shall automatically monitor controller and I/O point operation. System shall annunciate controller failure and I/O point locking (manual overriding to a fixed value).
6. Alarm messages shall use an English language descriptor without acronyms or mnemonics to describe alarm source, location, and nature.
7. The alarm management portion of the user interface shall, at the minimum, provide the following functions:
 - a. Log date and time of alarm occurrence.
 - b. Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm from the workstation or web browser interface.
 - c. Provide an audit trail on hard drive for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.
 - d. At minimum, direct alarms shall be able to log, print, start programs, display messages, send e-mail, send page, send text message, and audibly annunciate. BMS contractor shall coordinate implementation of this feature with the owner as part of the work of this project.
 - e. Any attribute of any object in the system may be designated to report an alarm.
 - f. The system shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions.
 - g. All specified alarms shall be shown on the correct system graphic, turn red and flash.
 - h. Alarm messages shall use an English language descriptor without acronyms or mnemonics to describe alarm source, location, and nature.
8. Operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk.
9. Operator shall be able to view, and to edit if applicable, the status of each system object and property by menu, on graphics, or through custom programs.
10. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.
11. Furnish the following standard system reports:
 - a. System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.

- b. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.
 - c. System shall log the following to a database or text file and shall retain data for an adjustable period:
 - 1) Alarm History.
 - 2) Operator shall be able to select trends to be logged.
 - 3) At a minimum, system shall log operator log in and log out, control parameter changes, schedule changes, and alarm acknowledgment and deletion. System shall date and time stamp logged activity.
12. Graphically based tools and documentation shall allow Operator to edit system graphics, to create graphics, and to integrate graphics into the system. Operator shall be able to add analog and binary values, dynamic text, static text, and animation files to a background graphic using a mouse.
13. Complete library of standard HVAC equipment graphics shall include equipment such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. Library shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. Library graphic file format shall be compatible with graphics generation tools.
14. Operator shall be able to create, edit, debug, and download custom programs. System shall be fully operable while custom programs are edited, compiled, and downloaded.
- E. Portable Operator's Terminal: Provide all necessary software to configure a Windows OS based laptop computer for use as a Portable Operator's Terminal. Operator shall be able to connect configured Terminal to the system network or directly to each controller for programming, setting up, and troubleshooting.

2.7 CONTROLLER SOFTWARE

- A. Building and energy management application software shall reside and operate in system controllers. Applications shall be editable through operator workstation, web browser interface, or engineering workstation.
- B. System shall provide the following schedule options as a minimum:
- 1. Provide separate schedules for each day of the week. Each schedule shall be able to include up to five (5) occupied periods (five (5) start-stop pairs or ten (10) events).
 - 2. Operator shall be able to designate an exception schedule for each of the next 365 days. After an exception schedule has executed, system shall discard and replace exception schedule with standard schedule for that day of the week.
 - 3. Operator shall be able to define twenty-four (24) special or holiday schedules of varying length on a scheduling calendar that repeats each year.
- C. System shall stagger controlled equipment restart after power outage. Operator shall be able to adjust equipment restart order and time delay between equipment restarts.
- D. Binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.
- E. System shall provide an algorithm that can totalize runtime for each binary input and output. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit.

F. Remote Communication

1. System shall automatically contact operator workstation or server on receipt of critical alarms. If no network connection is available, system shall use a modem connection.

G. Maintenance Management

1. System shall generate maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limits.

2.8 CONTROLLERS

A. General. Provide Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), Smart Actuators (SA), and Smart Sensors (SS) as required to achieve performance specified.

B. Communication

1. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on drawings.
2. Each piece of equipment specified on Drawings to be controlled or monitored by DDC system shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network.

C. Controller hardware shall be suitable for anticipated ambient conditions.

1. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 32° F to 120° F.
2. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -20° F to 140° F.

D. Provide a local keypad and display for each BC and AAC. Operator shall be able to use keypad to view and edit data. Keypad and display shall require password to prevent unauthorized use. If the manufacturer does not normally provide a keypad and display for each BC and AAC, provide the software and any interface cabling needed to use a laptop computer as a Portable Operator's Terminal for the system.

E. Controllers that perform scheduling shall have a real-time clock.

F. Serviceability

1. Controllers shall have diagnostic LEDs for power, communication, and processor.
2. Wires shall be connected to a field-removable modular terminal strip or to a termination card connected by a ribbon cable.
3. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.

G. Memory

1. Controller memory shall support operating system, database, and programming requirements.
 2. Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.
 3. Each ASC and SA shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.
- H. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

2.9 INPUT AND OUTPUT INTERFACE

- A. General: Hard-wire input and output points to BCs, AACs, ASCs, or SAs.
- B. Analog inputs shall monitor low-voltage (0-10 Vdc), current (4-20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.
- C. Binary outputs shall send an on-or-off signal for on and off control. Building Controller binary outputs shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.
- D. Analog outputs shall send a modulating 0-10 Vdc or 4-20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two (2)-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.
- E. Control three (3)-point floating electronic actuators without feedback with tri-state outputs (two (2) coordinated binary outputs). Tri-State outputs may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.
- F. Universal Inputs and Outputs: Inputs and outputs that can be designated as either binary or analog in software shall conform to the provisions of this section that are appropriate for their designated use.

2.10 AUXILIARY CONTROL DEVICES

- A. Binary Temperature Devices
1. Low-Voltage Space Thermostats: Low-voltage space thermostats shall be 24 V, bimetal-operated, with adjustable or fixed anticipation heater, digital temperature and setpoint display, 55° F - 85° F setpoint range, 2° F maximum differential, and vented ABS plastic cover.
 2. Line-Voltage Space Thermostats: Line-voltage space thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed

setpoint adjustment, 55° F - 85° F setpoint range, 2° F maximum differential, and vented ABS plastic cover.

3. Low-Limit Thermostats (Freezestats): Low-limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 20 ft. long. Element shall sense temperature in each 1 ft. section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only. Sensor shall be installed so the entire coil has coverage (1ft. of sensor / 1 sq. ft. of coil and provide multiple units if necessary to meet this requirement). The sensor shall not be installed more than 6" from the edge of the coil. The location of the reset head must be outside the plenum wall and at the highest point of the assembly. The sensing bulb shall be sloped continuously downward from the reset head.

B. Temperature Sensors

1. Type: Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.
2. Duct Sensors: Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 5 ft in length per 10 ft ² of duct cross-section.
3. Immersion Sensors: Provide immersion sensors with a separable stainless steel well. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities.
4. Space Sensors: Space sensors shall have setpoint adjustment, override switch, display, and communication port as shown.
5. Differential Sensors: Provide matched sensors for differential temperature measurement.

C. Humidity Sensors

1. Duct and room sensors shall have a sensing range of 20% - 80%.
2. Duct sensors shall have a sampling chamber.
3. Outdoor air humidity sensors shall have a sensing range of 10% - 95% RH and shall be suitable for ambient conditions of 40° F - 170° F.
4. Humidity sensors shall not drift more than 1% of full scale annually.

D. Flow Switches: Flow-proving switches shall be differential pressure type (air or water service) as shown. Switches shall be UL listed, SPDT snap-acting, and pilot duty rated (125 VA minimum).

1. Differential pressure switches shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

E. Relays

1. Control Relays: Control relays shall be plug-in type, UL listed, and shall have dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.

2. Time Delay Relays: Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable $\pm 100\%$ from setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.

F. Override Timers

1. Unless implemented in control software, override timers shall be spring-wound line voltage, UL Listed, with contact rating and configuration required by application. Provide 0-6 hour calibrated dial unless otherwise specified. Flush mount timer on local control panel face or where shown.

G. Current Transmitters

1. AC current transmitters shall be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4-20 mA two (2)-wire output. Full-scale unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment. Unit accuracy shall be $\pm 1\%$ full-scale at 500 ohm maximum burden.
2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.
3. Unit shall be split-core type for clamp-on installation on existing wiring.

H. Voltage Transmitters

1. AC voltage transmitters shall be self-powered single-loop (two (2)-wire) type, 4-20 mA output with zero and span adjustment.
2. Adjustable full-scale unit ranges shall be 100-130 Vac, 200-250 Vac, 250-330 Vac, and 400-600 Vac. Unit accuracy shall be $\pm 1\%$ full-scale at 500 ohm maximum burden.
3. Transmitters shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized at 600 Vac rating.

I. Power Monitors

1. Power monitors shall be three (3)-phase type and shall have three (3)-phase disconnect and shorting switch assembly, UL listed voltage transformers, and UL listed split-core current transformers.
2. Power monitors shall provide selectable output: Rate pulse for kWh reading or 4-20 mA for kW reading. Power monitors shall operate with five (5) A current inputs and maximum error of $\pm 2\%$ at 1.0 power factor or $\pm 2.5\%$ at 0.5 power factor.

J. Current Switches

1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.

K. Pressure Transducers

1. Transducers shall have linear output signal and field-adjustable zero and span.

2. Continuous operating conditions of positive or negative pressure 50% greater than calibrated span shall not damage transducer sensing elements.
3. Water pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 150 psi. Transducer shall have 4-20 mA output, suitable mounting provisions, and block and bleed valves.
4. Water differential pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 150 psi. Over-range limit (differential pressure) and maximum static pressure shall be 300 psi. Transducer shall have 4-20 mA output, suitable mounting provisions, and five (5)-valve manifold.

L. Differential Pressure Switches:

1. Differential pressure switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

M. Air Flow Measuring

1. Airflow measuring sensors shall be installed at fan inlet whenever possible and shall be capable of continuously measuring the air handling capacity (air volume) of the respective centrifugal, plug, or vane-axial fan(s).
2. Duct mounted: Thermal dispersion type. Units shall be provided complete with differential pressure transducers, temperature compensation, square root extraction. Unit shall perform all internal calculations to output to the FMS the CFM readings. Provide straight duct before and after device according to the sensor manufacturer's recommendations. Provide access door in ductwork adjacent to sensors.
3. Sensor accuracy shall be +/- 2% of the airflow reading over the entire range of airflow measured.
4. The transmitter shall be capable of displaying the airflow and temperature readings of individual sensors on the LCD display.

N. Gas Detection Equipment

1. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 32 to 104° F and calibrated for 0 to 2%, with continuous or averaged reading, 4-20 mA output, for wall mounting.
2. Carbon Monoxide Detectors: Refer to Specification 230913.
3. Oxygen Depletion Detectors: Refer to Specification 230913. Single detector using long life zirconium oxide sensors rated for a minimum of 8 years runtime; suitable over a temperature range of -40 to 134 F; rated for nitrogen gas compatibility; with dual level alarm relays (4-20 mA output) pre-calibrated to 18.0% and 19.5% O₂; integral audible alarm; 24 VDC powered; and wall mounted.

O. Local Control Panels

1. Indoor control panels shall be fully enclosed NEMA 1 construction with hinged door key-lock latch and removable sub-panels. A common key shall open each control panel and sub-panel.

2. Prewire internal and face-mounted device connections with color-coded stranded conductors tie-wrapped or neatly installed in plastic troughs. Field connection terminals shall be UL listed for 600 V service, individually identified per control and interlock drawings, with adequate clearance for field wiring.
3. Each local panel shall have a control power source power switch (on-off) with overcurrent protection.

2.11 WIRING

A. General Installation and Equipment Requirements

1. The Controls Installer as noted in the scope matrix shall provide and install conduit, hangers, supports, wiring, and cable to meet the requirements noted in applicable sections of the Division 26 specifications. This requirement will maintain a consistent level of quality for all wiring systems in the building.
2. Insulated wire shall use copper conductors and shall be UL listed for 90°C (200°F) minimum service.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Thoroughly examine project plans for control device and equipment locations. Report discrepancies, conflicts, or omissions to Architect or Engineer for resolution before starting rough-in work.
- B. Inspect site to verify that equipment can be installed as shown. Report discrepancies, conflicts, or omissions to Engineer for resolution before starting rough-in work.
- C. Examine drawings and specifications for work of others. Report inadequate headroom or space conditions or other discrepancies to Engineer and obtain written instructions for changes necessary to accommodate temperature controls work with work of others. ATC shall perform at his expense necessary changes in specified work caused by failure or neglect to report discrepancies.

3.2 PROTECTION

- A. Controls Contractor shall protect against and be liable for damage to work and to material caused by Controls Contractor's work or employees.
- B. Controls Contractor shall be responsible for work and equipment until inspected, tested, and accepted. Protect material not immediately installed. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of dust and foreign objects.

3.3 COORDINATION

A. Site

1. Assist in coordinating space conditions to accommodate the work of each trade where work will be installed near or will interfere with work of other trades. If installation without

coordination causes interference with work of other trades, Contractor shall correct conditions without extra charge.

2. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.

B. Test and Balance

1. Provide Test and Balance Contractor a single set of necessary tools to interface to control system for testing and balancing.
2. Train Test and Balance Contractor to use control system interface tools.
3. Test and Balance Contractor shall return tools undamaged and in working condition at completion of testing and balancing.

C. Life Safety

1. Duct smoke detectors required for air handler shutdown are provided under Division 28. Interlock smoke detectors to air handlers for shutdown as specified.
2. Smoke dampers and actuators required for duct smoke isolation are provided under Division 23. Interlock smoke dampers to air handlers as specified. Provide wiring to dampers as required.
3. Fire and smoke dampers and actuators required for fire-rated walls are provided under Division 23. Fire and smoke damper control is provided under Division 28.

D. Coordination with Other Controls: Integrate with and coordinate controls and control devices furnished or installed by others as follows.

1. Communication media and equipment shall be provided as specified.
2. Each supplier of a controls product shall configure, program, start up, and test that product to meet the sequences of operation described on Drawings regardless of where within the contract documents those products are described.
3. Coordinate and resolve incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.
4. Controls Contractor shall be responsible for integration of control products provided by multiple suppliers regardless of where integration is described within the contract documents.
5. The temperature control contractor shall provide all necessary additional sensors to execute all sequences as indicated on the construction documents. Coordinate additional requirements with equipment manufacturer.

3.4 GENERAL WORKMANSHIP

- A.** Install equipment, piping, conduit, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.

- B. Provide sufficient slack and flexible connections to allow for piping and equipment vibration isolation.
- C. Install equipment in readily accessible locations as defined by National Electrical Code (NEC) Chapter 1 Article 100 Part A.
- D. Verify wiring integrity to ensure continuity and freedom from shorts and ground faults.
- E. Equipment, installation, and wiring shall comply with industry specifications and standards and local codes for performance, reliability, and compatibility.
- F. Continually monitor field installation for code compliance and workmanship quality.

3.5 WIRING

- A. Control and interlock wiring and installation shall comply with national and local electrical codes, Division 26, and manufacturer's recommendations. Where the requirements of this section differ from Division 26, this section shall take precedence.
- B. Use color-coded conductors throughout.
- C. Locate control and status relays in designated enclosures only. Do not install control and status relays in packaged equipment control panel enclosures containing Class 1 starters.
- D. Terminate control and interlock wiring related to the work of this section. Maintain at the job site updated (as-built) wiring diagrams that identify terminations.
- E. Low-voltage wiring shall meet NEC Class 2 requirements. Subfuse low-voltage power circuits as required to meet Class 2 current limit.
- F. During installation do not exceed maximum cable pulling, tension, or bend radius specified by the cable manufacturer.
- G. NEC Class 2 (current-limited) wires not in conduit but in concealed and accessible locations such as return air plenums shall be UL listed for the intended application.
- H. Run exposed Class 2 wiring parallel to a surface or perpendicular to it and tie neatly at 10 ft. intervals.
- I. Use structural members to support or anchor plenum cables without conduit. Do not use ductwork, electrical conduits, piping, or ceiling suspension systems to support or anchor cables.
- J. Verify entire network's integrity following cable installation using appropriate tests for each cable.
- K. Install lightning arrestor according to manufacturer's recommendations between cable and ground where a cable enters or exits a building.
- L. Each run of communication wiring shall be a continuous length without splices when that length is commercially available. Runs longer than commercially available lengths shall have as few splices as possible using commercially available lengths.
- M. Label communication wiring to indicate origination and destination.

- N. Ground coaxial cable according to NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."
- O. NEC Class 1 (line voltage) wiring shall be UL listed in approved conduit as specified by NEC and Division 26.
- P. Install wiring in conduit where subject to mechanical damage and at levels below 10ft in mechanical, electrical, or service rooms.
- Q. Install Class 1 and Class 2 wiring in separate conduits. Install communication wiring in separate conduits and enclosures from other wiring.
- R. Boxes and panels containing high-voltage wiring and equipment shall not be used for low-voltage wiring except for the purpose of interfacing the two through relays and transformers.
- S. Do not install wiring in conduit containing pneumatic tubing.
- T. Secure conduits with conduit clamps fastened to structure and spaced according to code requirements. Conduits and pull boxes shall not be hung on or attached to ductwork, electrical conduits, piping, or ceiling suspension systems.
- U. Size conduit and select wire size and type in accordance with manufacturer's recommendations and NEC requirements.
- V. Include one (1) pull string in each conduit 1 in. or larger.
- W. Conceal conduits except within mechanical, electrical, or service rooms. Maintain minimum clearance of 6 in. between conduit and high-temperature equipment such as steam pipes or flues.
- X. Install insulated bushings on conduit ends and enclosure openings. Seal top ends of vertical conduits.
- Y. Flexible metal conduits and liquid-tight flexible metal conduits shall not exceed 3 ft in length and shall be supported at each end. Do not use flexible metal conduit less than 1/2 inch. Use liquid-tight flexible metal conduits in areas exposed to moisture including chiller and boiler rooms.
- Z. Install conduit rigidly, support adequately, ream at both ends, and leave clean and free of obstructions. Join conduit sections with couplings and according to code. Make terminations in boxes with fittings. Make terminations not in boxes with bushings.

3.6 INSTALLATION OF SENSORS

- A. Install sensors according to manufacturer's recommendations.
- B. Mount sensors rigidly and adequately for operating environment.
- C. Install room temperature sensors on concealed junction boxes properly supported by wall framing.
- D. Install all controls devices, sensors, & equipment that is operable or has user adjustment at 42" above finished floor. Dimensions shall be measured from the floor level to the centerline of the device.

- E. Air seal wires attached to sensors in their raceways or in the wall to prevent sensor readings from being affected by air transmitted from other areas.
- F. Use averaging sensors in mixing plenums and hot and cold decks. Install averaging sensors in a serpentine manner vertically across duct. Support each bend with a capillary clip.
- G. Install mixing plenum low-limit sensors in a serpentine manner horizontally across duct. Support each bend with a capillary clip. Provide one (1) ft of sensing element for each one (1) ft² of coil area.
- H. Install pipe-mounted temperature sensors in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.
- I. Install outdoor air temperature sensors on north wall at designated location with sun shield.
- J. Differential Air Static Pressure
 - 1. Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
 - 2. Building Static Pressure. Pipe pressure sensor's low-pressure port to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe high-pressure port to a location behind a thermostat cover.
 - 3. Piping to pressure transducer pressure ports shall contain a capped test port adjacent to transducer.
 - 4. Pressure transducers, except those controlling VAV boxes, shall be located in control panels, not on monitored equipment or on ductwork. Mount transducers in a vibration-free location accessible for service without use of ladders or special equipment.
 - 5. Mount gauge tees adjacent to air and water differential pressure taps. Install shut-off valves before tee for water gauges.
- K. Smoke detectors, freezestats, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Provide contacts that allow DDC software to monitor safety switch status.

3.7 ACTUATORS

- A. General: Mount actuators and adapters according to manufacturer's recommendations.

3.8 WARNING LABELS

- A. Affix permanent warning labels to all equipment that can be automatically started by the control system.
 - 1. Label: Labels shall use white lettering (18-point type or larger) on a red background. Size labels such that they are readily visible when approaching equipment for service.
 - 2. Install labels on equipment in locations of moving parts or electrical hazards such as access doors air handler fan sections, duct mounted heater control panels, pump shaft coupling guards, etc.

3. Warning labels shall read as follows:

<p style="text-align: center;">CAUTION</p> <p>This equipment is operating under automatic control and may start or stop at any time without warning.</p> <p style="text-align: center;">Switch disconnect to "Off" position before servicing.</p>
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- B. Affix permanent warning labels to motor starters and control panels that are connected to multiple power sources utilizing separate disconnects.
1. Labels shall use white lettering (twelve (12)-point type or larger) on a red background.
 2. Warning labels shall read as follows:

<p style="text-align: center;">CAUTION</p> <p>This equipment is fed from more than one (1) power source with separate disconnects.</p> <p style="text-align: center;">Disconnect all power sources before servicing.</p>

3.9 IDENTIFICATION OF HARDWARE AND WIRING

- A. Label wiring and cabling, including that within factory-fabricated panels, with control system address or termination number at each end within two (2) inches of termination.
- B. Permanently label or code each point of field terminal strips to show instrument or item served.
- C. Label control panels per Mechanical Identification specification.
- D. Label each control component with a permanent label. Label plug-in components such that label remains stationary during component replacement.
- E. Label room sensors (not thermostats) related to terminal boxes or valves with nameplates.
- F. Manufacturers' nameplates and UL or CSA labels shall be visible and legible after equipment is installed.
- G. Naming convention shall match Contract Drawings.
- H. Label identifiers shall match record documents.

3.10 CONTROL SYSTEM CHECKOUT AND TESTING

- A. Startup Testing. Complete startup testing to verify operational control system before notifying Owner of system demonstration. Provide Owner with schedule for startup testing. Owner may have representative present during any or all startup testing.
 1. Calibrate and prepare for service each instrument, control, and accessory equipment furnished under the scope of the Contract.
 2. Verify that control wiring is properly connected and free of shorts and ground faults. Verify that terminations are tight.
 3. Enable control systems and verify each input device's calibration. Calibrate each device according to manufacturer's recommendations.

4. Verify that binary output devices such as relays, solenoid valves, two (2)-position actuators and control valves, and magnetic starters, operate properly and that normal positions are correct.
5. Verify that analog output devices such as I/Ps and actuators are functional, that start and span are correct, and that direction and normal positions are correct. Check control valves and automatic dampers to ensure proper action and closure. Make necessary adjustments to valve stem and damper blade travel.
6. Prepare a log documenting startup testing of each input and output device, with technician's initials certifying each device has been tested and calibrated.
7. Verify that system operates according to sequences of operation. Simulate and observe each operational mode by overriding and varying inputs and schedules. Tune PID loops and each control routine that requires tuning.
8. Alarms and Interlocks
 - a. Check each alarm with an appropriate signal at a value that will trip the alarm.
 - b. Trip interlocks using field contacts to check logic and to ensure that actuators fail in the proper direction.
 - c. Test interlock actions by simulating alarm conditions to check initiating value of variable and interlock action.

3.11 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

- A. Demonstration: Prior to acceptance, perform the following performance tests to demonstrate system operation and compliance with specification after and in addition to tests specified in Control System Checkout and Testing. Provide Engineer with log documenting completion of startup tests.
 1. Complete approved checklists and forms for each system as part of system demonstration.
 2. Demonstrate actual field operation of each specified sequence of operation. Provide at least two (2) persons equipped with two (2)-way communication. Demonstrate calibration and response of any input and output points requested by Engineer. Provide and operate test equipment required to prove proper system operation.
 3. Demonstrate compliance with sequences of operation through each operational mode.
 4. Demonstrate complete operation of operator interface.
 5. Demonstrate each of the following.
 - a. Each sample's trend data shall show setpoint, actuator position, and controlled variable values. Engineer will require further tuning of each loop that displays unreasonably under- or over-damped control.
 - b. Building fire alarm system interface.
 - c. Trend data shall indicate setpoints, operating points, valve positions, and other data as specified in the sequence of operation. Each log shall cover three (3) forty-eight (48)-hour periods and shall have a sample frequency not less than ten (10) minutes or as specified.

6. Tests that fail to demonstrate proper system operation shall be repeated after Contractor makes necessary repairs or revisions to hardware or software to successfully complete each test.

B. Acceptance

1. After tests described in this specification are performed to the satisfaction of both Engineer and Owner, Engineer will accept control system as meeting completion requirements. Engineer may exempt tests from completion requirements that cannot be performed due to circumstances beyond Contractor's control. Engineer will provide written statement of each exempted test. Exempted tests shall be performed as part of warranty.

3.12 CLEANING AND REPAIR

- A. On completion of Work, check equipment furnished under this section for paint damage. Repair damaged factory-finished paint to match adjacent areas. Replace deformed cabinets and enclosures with new material and repaint to match adjacent areas.
- B. Clean the outside of all cabinets and sensor enclosures.

3.13 TRAINING

- A. Provide training for a designated staff of Owner's representatives. Training shall be provided via self-paced training, web-based or computer-based training, classroom training, or a combination of training methods.
- B. Training shall enable students to accomplish the following objectives.
 1. Proficiently operate system
 2. Understand control system architecture and configuration
 3. Understand DDC system components
 4. Understand system operation, including DDC system control and optimizing routines (algorithms)
 5. Operate workstation and peripherals
 6. Log on and off system
 7. Access graphics, point reports, and logs
 8. Adjust and change system setpoints, time schedules, and holiday schedules
 9. Recognize common HVAC system malfunctions by observing system graphics, trend graphs, and other system tools
 10. Understand system drawings and Operation and Maintenance manual
 11. Understand job layout and location of control components
 12. Access data from DDC controllers

- 13. Operate portable operator's terminals
- 14. Configure and run reports
- C. Divide presentation of objectives into three (3) sessions. Participants will attend one (1) or more of sessions, depending on knowledge level required.
- D. Provide one (1) copy of training manual for each student.
- E. Provide complete training for each shift of staff.
- F. Include a minimum of eight (8) total hours of on-site training in bid.
- G. Instructors shall be factory-trained and experienced in presenting this material.
- H. Perform classroom training using a network of working controllers, representative of installed hardware.

END OF SECTION

SECTION 23 1126 – NATURAL GAS PIPING

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the following Natural gas Piping System indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Equipment Included in This Section
 - 1. Piping
 - 2. Regulators
 - 3. Unions
 - 4. Valves

1.2 REFERENCES

- A. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. Adopted version of the International Fuel Gas Code.
 - 2. Adopted version of NFPA 54, National Fuel Gas Code.
 - 3. ASME as it pertains to the welding of piping.
 - 4. State Boiler Code

1.3 SUBMITTALS

- A. Product Data
 - 1. Catalog sheets and specifications indicating manufacturer name, type, applicable reference standard, schedule, or class for specified pipe and fittings.
 - 2. Material Schedule: Itemize pipe and fitting materials for each specified application in Pipe and Fittings Schedule in Part 3 of this Section. Where optional materials are specified indicate option selected.
- B. Submit piping layout drawings as per Section 230500.

1.4 QUALITY ASSURANCE

- A. All materials, equipment and Work shall meet or exceed all applicable federal, state and local requirements and conform to codes and ordinances of authorities having jurisdiction.

- B. Valves: Manufacturer's name, size, standards compliance and pressure rating clearly marked on outside of valve body.
- C. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.
- E. Installer Qualifications: Company specializing in performing the Work of this Section with minimum three (3) years documented experience. All installation shall be supervised by a licensed Master Plumber. All testing shall be performed by a licensed Journeyman or Master Plumber. Welders shall be certified in accordance with ASME.

1.5 EXTRA MATERIALS

- A. Provide one (1) plug valve wrench for every ten (10) plug valves sized 2 inches and smaller, minimum of one (1). Provide each plug valve sized 2-1/2 inches and larger with a wrench incorporating a setscrew.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. Natural gas pressures shall not exceed two (2) pounds per square inch gauge on customer side of the meter.
- C. Pipe joint compound shall be lead-free, non-toxic, non-hardening, insoluble in the presence of natural gas and compliant with ANSI/NSF 61 and Federal Specification TT-S-1732. Temperature service range of -15° F to +400° F.

2.2 PIPING

- A. Steel Piping
 - 1. Schedule 40 black steel, ASTM A53, Grade A or B, seamless or electric resistance welded.
 - a. Malleable Iron, Steam Pattern Threaded Fittings
 - 1) 150 lb Class: ASME B16.3
 - b. Schedule 40 Carbon Steel Fittings
 - 1) ASME B16.9
- B. Corrugated Stainless Steel Tubing (CSST) & Fittings
 - 1. Tubing shall be made from 300 series stainless steel strip conforming to ASTM A240 & shall be suitable for operation with fuel gases.
 - 2. Tubing shall be rated for a minimum of 25 PSI operating pressure.

3. Tubing come with a factory installed, integral polyethylene sleeve. The polyethylene sleeve shall have internal vent channels lengthwise to direct any leakage along the pipe to the end fittings. The construction of the pre-sleeved system shall provide the code required encasement & venting capabilities of the system.
4. All fittings shall be non-gasketed, CSA International listed for installation in concealed locations, & constructed of yellow brass with a stainless steel insert.
5. All fittings shall be provided with a plastic containment coupling & a ¼" NPT vent port to provide venting as required.
6. The underground piping system shall be listed by the International Code Council (ICC) or the International Association of Plumbing & Mechanical Officials (IAPMO) for underground or underground beneath building applications
7. Vent pipe material shall be schedule 40 black steel. All vent piping shall be routed & terminated per the International Fuel Gas Code & NFPA 54 requirements.
8. Approved manufacturers: TracPipe PS-II or prior approved equal.

2.3 EXCEPTIONS

- A. Gas piping is prohibited from being installed in solid partitions or walls unless a chase or casing (pipe sleeve) is provided.
- B. Threaded fittings shall not be used for pipe sizes 4 inches and larger.

2.4 VALVES

- A. Acceptable Manufacturers:
 1. A.Y. McDonald
 2. Nibco
 3. Milwaukee
 4. Nordstrom
 5. Mueller.
- B. All valves shall be designed, manufactured and approved for natural gas service.
- C. Line Shut-off Valves sizes 2" and smaller:
 1. Iron body lubricated plug valve conforming to ASME B16.33, U.L. Listed, and A.G.A. Approved for natural gas service with threaded ends, wrench operation, rated for 200 WOG service pressure and -20 to 200° F.
 2. Brass body, full port ball valve conforming to ASME B16.33, U.L. Listed. Blowout-proof stem and PTFE seats. Approved for natural gas service up to and including 5 psig with threaded ends, rated for 125 psig working pressure and -4 to 200°F working temperature.

D. Line Shut-off Valves sizes 2 1/2" and larger:

1. Iron body lubricated plug valve conforming to ASME B16.44, U.L. Listed, and A.G.A. Approved for natural gas service with flanged ends, wrench operation, rated for 200 WOG service pressure and -20 to 200° F.
2. Brass body, full port ball valve (2-1/2" – 4") conforming to ASME B16.44 and U.L. Listed. Blowout-proof stem and PTFE seats. Approved for natural gas service up to and including 5 psig with threaded ends, rated for 250 psig working pressure and -4 to 200°F working temperature.

E. Appliance/Equipment Shut-off Valves at local connections sizes two (2) inches and smaller shall be bronze body, full port ball or butterfly type, U.L. Listed, and A.G.A. Approved for natural gas service with threaded ends, quarter turn lever handle operation, rated for 175 W.O.G. service pressure and 30 to 275° F.

F. Manual Emergency Shut-off Valves 2" and smaller shall be bronze body, full port ball or butterfly type, U.L. Listed, and A.G.A. Approved for natural gas service with threaded ends, quarter turn lever handle operation, rated for 175 W.O.G. service pressure and 30 to 275° F.

G. Automatic Emergency Shut-off Valves shall be U.L. Listed for natural gas service, two (2)-way electrically tripped solenoid type; fail safe closed; manual reset; Type 1 solenoid enclosure; NBR seals and disc; stainless steel core tube and springs; copper coil.

2.5 PRESSURE REGULATORS

A. Acceptable Manufacturers:

1. Fisher
2. Maxitrol
3. Rockwell
4. Schlumberger.

B. All pressure regulators shall be designed, manufactured and approved for natural gas service.

C. Pressure regulators for individual service lines shall be capable of reducing distribution line pressure to pressures required for equipment. Pressure relief shall be set at a lower pressure than would cause unsafe operation of any connected unit. Regulator shall have a single port with orifice diameter no greater than that recommended by manufacturer for the maximum gas pressure at the regulator inlet. Regulator vent valve shall be of resilient materials designed to withstand flow conditions when pressed against valve port. Regulator shall be capable of limiting build-up of pressure under no-flow conditions to 50 percent or less of the discharge pressure maintained under flow conditions. Commercial grade diaphragm type with internal relief valve, vent valve, cast iron body, Buna-N diaphragm.

D. Install pressure gauge adjacent to and downstream of each line pressure regulator.

2.6 UNIONS

A. Unions in 2" and smaller in ferrous lines shall be Class 300 AAR malleable iron unions with iron to brass seats, 2-1/2" and larger shall be ground flange unions. Companion flanges on lines at

various items of equipment, machines and pieces of apparatus may serve as unions to permit disconnection of piping.

- B. Unions connecting ferrous pipe to copper or brass pipe shall be Epco dielectric type.
- C. Above grade flexible stainless steel appliance/equipment connectors shall conform with AGA under the ANSI Z21.69 Standard. Hose shall be braided stainless steel with a polyolefin heat-shrink tubing with high flame-retardant qualities. Hose shall be equipped with malleable iron unions and spring loaded brass quick-link couplings. An easily accessible manual shut-off valve shall be installed ahead of all hose connections. Specify T&S Brass "Safe-T-Link" or approved equal.

2.7 FLANGES

- A. All 150 lb. and 300 lb. ANSI flanges shall be domestically manufactured, weld neck forged carbon steel, conforming to ANSI B16.5 and ASTM A-181 Grade I or II or A-105-71. Slip on flanges shall not be used.
- B. Each fitting shall be stamped as specified by ANSI B16.9 and, in addition, shall have the laboratory control number stenciled on each fitting for ready reference as to physical properties and chemical composition of the material. Complete test reports may be required for any fitting selected at random.
- C. Flanges which have been machined, remarked, painted or otherwise produced domestically from imported forges will not be acceptable. Flanges shall have the manufacturer's trademark permanently identified in accordance with MSS SP-25.
- D. Bolts used shall be carbon steel bolts with semi-finished hexagon nuts of American Standard Heavy dimensions. Threaded rods will not be an acceptable alternate for flange bolts. Bolts shall have a tensile strength of 60,000 psi and an elastic limit of 30,000 psi.
- E. Flat-faced flanges shall be required to match flanges on pumps, check valves, strainers, etc. Only one (1) manufacturer of weld flanges will be approved for each project.
- F. All flanges shall be gasketed. Contractor shall place gasket between flanges of flanged joints. Gaskets shall fit within the bolt circle on raised face flanges and shall be full face on flat face flanges. Gaskets shall be cut from 1/16" thick, non metallic, non asbestos gasket material suitable for operating temperatures from -150° F to +75° F.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE AND HANDLING

- A. Accept piping, fittings, and accessories on Site in shipping containers with labeling in place, inspect for damage and store with a minimum of handling. Store plastic piping under cover out of direct sunlight. Do not store materials directly on the ground.
- B. Provide temporary protective coating on all cast iron and steel devices.
- 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.

3.2 PREPARATION

- A. Ream pipe ends and remove cutting burrs. Bevel plain end ferrous pipe.
- B. Remove cutting oil, scale and dirt, on inside and outside of piping, before assembly.

3.3 PAINTING

- A. Prepare all piping as needed to allow for proper coverage and adherence.
- B. Piping to be painted includes the following:
 - 1. Exterior to building: Color selected by Architect.
 - 2. Interior to building: Yellow

3.4 EQUIPMENT CONNECTIONS

- A. Provide specified connections, shutoff valves, regulators and unions at each and every appliance and piece of equipment requiring natural gas, including equipment furnished under other Divisions of these Specifications and/or by the Owner.
- B. Provide and install union type connections at all equipment to permit removal of service piping.
- C. Gas service connections shall have a diameter at least one (1) pipe size larger than that of the inlet connection to the equipment as provided by the manufacturer and be of adequate size to provide the total input demand of the connected equipment.
- D. Provide listed and labeled appliance connectors complying with ANSI Z21.69 and listed for use with food service equipment having casters, or that is otherwise subject to movement for cleaning, and other large movable equipment. Connectors shall have listed and labeled quick-disconnect devices and shall have retaining cables attached to structures and equipment. Connectors shall not be concealed within or extended through wall, floor or partition and shall be located entirely in the same room as the connected equipment. Provide an accessible shut-off valve not less than the nominal size of the equipment connector, immediately ahead of the connector.
- E. Rigid metallic pipe and fittings shall be used at service connections to all permanently stationary equipment.

3.5 INSTALLATION - GENERAL

- A. All gas piping installed in return air plenums shall be welded.
- B. Valves shall not be installed in concealed locations and return air plenums.
- C. Line shutoff valves installed exterior to the building shall be plug valves. Line shutoff valves installed interior to the building shall be full-port ball valves.

- D. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- E. All installation shall be in accordance with manufacturer's published recommendations.
- F. Provide support for and connections to natural gas service meter in accordance with requirements of the utility company.
- G. All installation shall be in accordance with manufacturer's published recommendations.
- H. All above ground gas piping shall be electrically continuous and bonded to electrical system ground conductor in accordance with NFPA 70.
- I. Provide and install unions at proper points to permit dismantling or removal of pipe. No unions will be required in welded lines except at equipment connections.
- J. Provide dielectric isolation device where copper lines connect to ferrous lines or equipment, such as dielectric union, coupling or dielectric flange fitting.
- K. Valves, regulators, flanges, unions and similar appurtenances shall be accessible for operation and servicing and shall not be located above ceilings in accessible locations or within partitions.
- L. Route piping in orderly manner and maintain gradient. Install piping to conserve building space. Group piping whenever practical at common elevations.
- M. Install piping to allow for expansion and Contraction without stressing pipe, joints, or connected equipment.
- N. Make service connections at the top of the main, whenever the depth of the main is sufficient to allow top connections. When service connections cannot be made at the top of the main, they shall be made on the side of the main no lower than the horizontal midpoint of the gas main.
- O. Cross type fittings shall not be installed in any gas line. Bushings shall not be used in conjunction with any gas piping.
- P. Slope piping and arrange to drain at low points. Install drip/sediment traps at points where condensate and debris may collect. Locate drip/sediment traps where readily accessible for cleaning and emptying. Do not install where condensate would be subject to freezing. Construct drip/sediment traps using tee fitting with capped nipple connected to bottom outlet. Use minimum-length nipple of three (3) pipe diameters, but not less than 4 inches long, and same size as connected pipe. Cap shall be screwed pattern, black, standard weight, malleable iron. Install with adequate space for removal of cap.
- Q. Install valves for shut off and to isolate equipment, parts of systems, or vertical risers. All valves shall be located such that servicing and operation is possible. All flanged valves shown in horizontal lines with the valve stem shall be positioned so that the valve stem is inclined one bolt hole above the horizontal position. Screw pattern valves placed in horizontal lines shall be installed with their valve stems inclined at an angle of a minimum of 30 degrees above the horizontal position. All valves must be true and straight at the time the system is tested and inspected for final acceptance. Valves shall be installed as nearly as possible to the locations indicated in the Contract Drawings. Any change in valve location must be so indicated on the Record Drawings.
- R. Install line shut-off valve at each branch connection to riser. Branch line shut-off valves shall be automatic type where indicated on Drawings.

- S. Provide adequate clearance for access to and operation of all valves.
- T. Install valves with stems upright or horizontal, not inverted unless required otherwise by the valve manufacturer.
- U. Pipe vents from gas pressure reducing valves and pipe casing sleeves to the exterior of the building and terminated with outlet turned down and capped with corrosion resistant insect screen. Vent terminations shall be at least seven feet above grade or pedestrian traffic and a minimum five (5) feet above or ten (10) feet horizontally from all air intakes or building openings.
- V. Above ground horizontal natural gas and encasement piping shall be supported at intervals of no greater than 6 foot for 1/2" piping, 8 foot for 3/4" and 1" piping and 10 foot for 1-1/4" and larger piping. Vertical piping shall be supported at each floor level and at intervals as specified for horizontal piping.
- W. Extension bars shall not be used for supporting gas or encasement piping. Gas or encasement piping shall not be used to support any other piping or component.

3.6 INSTALLATION - WELDED PIPING

- A. Welding of pipe in normally occupied buildings is prohibited. Off-Site welding is acceptable. Should welding be required in a normally occupied building for connecting to an existing welded system, obtain written approval from the General Contractor and comply with Owner's fire and life safety requirements.
- B. Piping and fittings shall be welded and fabricated in accordance with ASME/ANSI.
- C. Ensure complete penetration of deposited metal with base metal. Provide filler metal suitable for use with base metal. Maintain inside of fittings free from globules of weld metal. All welded pipe joints shall be made by the fusion welding process, employing a metallic arc or gas welding process. All pipes shall have the ends beveled 37 1/2 degrees and all joints shall be aligned true before welding. Except as specified otherwise, all changes in direction, intersection of lines, reduction in pipe size and the like shall be made with factory-fabricated welding fittings. Mitering of pipe to form elbows, notching of straight runs to form tees, or any similar construction will not be permitted.
- D. Align piping and equipment so that no part is offset more than 1/16". Set all fittings and joints square and true and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.
- E. Contractor shall not permit any weld to project within the pipe so as to restrict it. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welded during welding operation.
- F. In no cases shall Schedule 40 pipe be welded with less than three (3) passes including one (1) stringer/root, one (1) filler and one (1) lacer. Schedule 80 pipe shall be welded with not less than four (4) passes including one (1) stringer/root, two (2) filler and one (1) lacer. In all cases, however, the weld must be filled before the cap weld is added.

3.7 INSTALLATION – CORRUGATED STAINLESS STEEL TUBING

- A. Install and support all corrugated stainless steel tubing in accordance with manufacturer's recommendations.

- B. All piping system vents shall be routed to the building exterior per code & local AHJ requirements.

3.8 WELD TESTING

- A. All welds are subject to inspection, visual and/or x-ray, for compliance with Specifications. At the Owner's option, the Owner will provide employees or employ a testing laboratory for the purposes of performing said inspections and/or x-ray testing. Initial visual and x-ray inspections will be provided by the Owner. The Contractor shall be responsible for all labor, material and travel expenses involved in the re-inspection and retesting of any welds found to be unacceptable. In addition, the Contractor shall be responsible for the costs involved in any and all additional testing required or recommended by ASME/ANSI Standards B31.1 and B31.3 due to the discovery of poor, unacceptable or rejected welds.
- B. Welds lacking penetration, containing excessive porosity or cracks, or are found to be unacceptable for any reason, must be removed and replaced with an original quality weld as specified herein. All qualifying tests, welding and stress relieving procedures shall, moreover, be in accord with Standard Qualification for Welding Procedures, Welders and Welding Operators, Appendix A, Section 6 of the Code, current edition.

3.9 TESTING

- A. All natural gas systems shall be inspected, tested, purged and placed into operation in accordance with NFPA 54 and as required herein.
- B. All natural gas piping systems shall be very carefully inspected, tested, purged and placed into operation by a Licensed Plumber.
- C. All necessary apparatus for conducting tests shall be furnished by the Contractor and comply with the requirements of NFPA 54.
- D. All new rough-in distribution piping and affected portions of existing systems connected to, shall be subjected to a pneumatic test pressure utilizing clean, dry air and must be demonstrated to be absolutely tight when subjected to the pressures and time durations listed herein. All equipment and components designed for operating pressures of less than the test pressure shall not be connected to the piping system during test.
- E. Systems on which the normal operating pressure is less than 0.5 pounds per square inch gauge (psig), the test pressure shall be 5.0 psig and the time interval shall be thirty (30) minutes.
- F. Systems on which the normal operating pressure is between 0.5 psig and 5.0 psig, the test pressure shall be 1.5 times the normal operating pressure or 5.0 psig, whichever is greater, and the time interval shall be thirty (30) minutes.
- G. Systems on which the normal operating pressure is 5.0 psig or greater, the test pressure shall be 1.5 times the normal operating pressure, and the time interval shall be one (1) hour.
- H. After testing is complete, the entire gas system shall be purged with dry nitrogen to eliminate all air, debris and moisture from the piping before natural gas is introduced into the system.
- I. After successful results of pressure test and purging have been completed, a leakage test shall be performed in accordance with NFPA 54 Appendix D.

- J. Connect, inspect and purge gas utilization equipment, lab hook-ups, outlets, etc., and place into operation only after successful results of pressure test, leakage test and purging have been completed and accepted.
- K. In all instances in which leaks are then found, they shall be eliminated. Testing operations shall be repeated until gas-piping systems are absolutely tight at the pneumatic test pressures indicated above.
- L. Pressure test gas piping sleeve system with clean, dry compressed air at 15 psig by temporarily sealing all openings between gas carrier pipe and sleeve and vent openings. Sleeve systems must be demonstrated to be absolutely tight when subjected to this pressure for a period of four (4) hours.

END OF SECTION

SECTION 23 3113 – METAL DUCTWORK

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all work required to provide and install the Ductwork Insulation indicated by the Contract Documents with supplementary items necessary for proper installation.

1.2 REFERENCES

- A. National Fire Protection Association (NFPA)
- B. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
- C. Definition
 - 1. Low Pressure
 - a. 2 inch W.G. Pressure Class: Ductwork systems up to 2 inch w.g. positive or negative static pressure with velocities less than or equal to 1500 fpm.
 - 2. Medium Pressure
 - a. 3 inch W.G. Pressure Class: Ductwork systems over 2 inch w.g. and up to 3 inch W.G. positive or negative static pressure with velocities less than or equal to 2500 fpm.
 - b. 4 inch W.G. Pressure Class: Ductwork systems over 3 inch w.g. and up to 4 inch w.g. positive or negative static pressure with velocities less than or equal to 2500 fpm.
 - c. 6 inch W.G. Pressure Class: Ductwork systems over 4 inch w.g. and up to 6 inch w.g. positive or negative static pressure with velocities less than or equal to 2500 fpm.
 - 3. High Pressure
 - a. 10 inch W.G. Pressure Class: Ductwork systems over 6 inch w.g. and up to 10 inch w.g. positive or negative static pressure with velocities greater than 2500 fpm.

1.3 SUBMITTALS

- A. Shop Drawings
 - 1. Submit CAD drawn duct layout drawings for all project ductwork. Submit detailed elevations and sections where required to convey complete scope of work. Shop drawings shall be based on other trades contract drawings and field dimensions. Submit drawings on full size paper at 1/4" = 1'-0" scale.
- B. Coordinate shop drawings with related contractors prior to submission.
- C. Product Data: Material, gauge, type of joints, sealing materials, and reinforcing for each duct size range, including sketches or SMACNA plate numbers for joints, method of fabrication and reinforcing. Include ACGIH figure numbers for hoods if applicable.

1.4 QUALITY ASSURANCE

- A. SMACNA: Gauges of materials, fabrication, reinforcement, sealing requirements, installation, and method of supporting ductwork shall be in accordance with the following SMACNA manuals, unless otherwise shown or specified:
 - 1. HVAC Duct Construction Standards
- B. Unless otherwise shown or specified, follow the Hood Design Data, and Construction Guidelines for Local Exhaust Systems from the ACGIH Industrial Ventilation Manual.
- C. Conform to the applicable requirements of NFPA 90A, 90B, 91, 96, and 101.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Sheet Metal
 - 1. Aluminum: ASTM B-209, Alloy 3003, Temper H-14.
 - 2. Carbon Steel: 16 gauge black iron
 - 3. Galvanized Steel: ASTM A653, ASTM A924, Class LFQ (lock forming quality), coating designation G-60.
 - 4. Stainless Steel: AISI Types 302, 304 and 316, as specified.
- B. Duct Hangers
 - 1. Strap Hangers: Same material as ducts, except that hangers for stainless steel ducts in unfinished spaces may be galvanized steel.
 - 2. Rod Type Hangers: Mild low carbon steel, unless otherwise specified; fully threaded or threaded each end, with 2 removable nuts each end for positioning and locking rod in place. Unless stainless steel, galvanized or cadmium plated; shop coat with metal primer.
- C. Miscellaneous Fasteners and Upper Hanger Attachments
 - 1. Sheet Metal Screws, Machine Bolts and Nuts: Same material as duct, unless otherwise specified.
 - 2. Concrete Inserts: Steel or malleable iron, galvanized; continuously slotted or individual inserts conforming with MSS SP-58, Types 18 & 19, Class A-B.
 - 3. C Clamps: Fee & Mason Co.'s 255L with locking nut, and 255S with retaining strap.
 - 4. Metal Deck Ceiling Bolts: B-Line Systems, Inc.'s Fig. B3019.
 - 5. Welding Studs: Erico Fastening Systems, capacitor discharge, low carbon steel, copper flashed.

6. Structural (carbon) Steel Shapes and Steel Plates: ASTM A36, shop primed.
7. Stainless Steel Shapes and Plates: ASTM A276 and ASTM A666.
8. Machine Bolt Expansion Anchors
 - a. Non-caulking single unit type: FS FF-S-325, Group II, Type 2, Class 2, Style 1.
 - b. Non-caulking double unit type: FS FF-S-325, Group II, Type 2, Class 2, Style 2.
 - c. Self-drilling type: FS FF-S-325, Group III, Types 1 and 2.

2.2 FABRICATION – GENERAL

- A. Refer to the ductwork application schedule on the drawings for the types and material usage for the various ductwork types required.

2.3 FABRICATION OF STAINLESS STEEL DUCTS

- A. Use minimum No. 18 gauge for exhaust ducts connected to cooking equipment hoods. Use minimum No. 20 gauge for exhaust ducts connected to other hoods. Use minimum 26 gauge for dryer exhaust ducts.
- B. Use stainless steel reinforcing members for ducts in finished spaces and galvanized steel in unfinished spaces.
- C. Longitudinal Seams for Dishwashing, and Other Scullery Equipment Exhaust Ducts: Form double corner seams, or Pittsburgh lock seams.
 1. Fabricate elbows and transitions with Pittsburgh lock seams.
 2. Fabricate double compounded elbows and other complex fittings with double corner seams.
 3. Locate seams in horizontal ducts at top corners of ducts, unless otherwise approved in writing.
 4. Locate seams in vertical ducts at rear corners of ducts.
- D. All exposed stainless steel ductwork shall have a #3 finish.

2.4 VIBRATION ISOLATION FOR DUCTWORK

- A. Type: Combination rubber and spring type designed for insertion in a split hanger rod for isolating ductwork from the overhead construction.
 1. Approved isolators: Amber Booth Type BSSR, Korfund Type VX, Mason Industries, Type DNHS, Vibration Eliminator Co. Type SNRC and Vibration Mountings and Controls Type RSH.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

- A. Install ductwork to allow maximum headroom. Properly seam, brace, stiffen, support, and

render ducts mechanically airtight. Adjust ducts to suit job conditions. Dimensions may be changed as approved if cross sectional area is maintained.

- B. Pitch horizontal ducts connected to hoods downward toward hood not less than 1 inch in 10 feet.
- C. Provide necessary transformation pieces, and flexible fabric connections for ductwork connected to air handling equipment or air inlet and outlet devices. Flexible fabric connections installed at equipment exterior to the building shall be rated for UV exposure and suitable for exterior use per ASTM G155 leasing requirements. Metal for these connections shall be aluminum or stainless steel, galvanized connections shall not be allowed.

3.2 SEALING SEAMS, JOINTS, AND PENETRATIONS

- A. Seal ductwork in accordance with the SMACNA Manual except for the following:
 - 1. Ductwork Specified to be Insulated: Conform with Seal Class A for all pressure classes.
 - 2. Cooking Equipment Exhaust Ductwork: Conform with NFPA 96.
 - 3. Horizontal Ductwork for Dishwashing, and Other Scullery Equipment Exhausts
 - a. Continuously solder transverse joints vaportite along bottom, and up both sides two (2) inches minimum.
 - b. Continuously solder longitudinal seams vaportite if seams are approved to be located at bottom of duct.
 - 4. Exhaust ductwork joints shall not use sheetmetal screws or other fasteners that protrude into the ductwork to catch lint and debris. Ducts shall insert and adjoin to the next duct or fitting in the direction of airflow. Seal all joints and seams vapor tight with ductwork foil tape.

3.3 HANGERS FOR DUCTS, UNDER 2 INCHES W.G.

- A. Install hangers for ducts as specified in the SMACNA Manual, with the following exceptions:
 - 1. Rectangular ducts up to 42 inches wide, not having welded or soldered seams, and supported from overhead construction; extend strap hangers down over each side of the duct and turn under bottom of duct a minimum of two (2) inches. Secure hanger to duct with three (3) full thread sheet metal screws, one (1) in the bottom and two (2) in the side of the duct.
 - 2. Rectangular ducts 43 inches wide and over, and all sizes of duct with welded or soldered seams, and supported from overhead construction; use trapeze hangers.
 - 3. Prime coat plain steel rods threaded at the site immediately after installation with metal primer.
 - 4. Dryer exhaust ductwork shall be supported at 48 inch intervals.

3.4 HANGERS FOR DUCTS, 2 INCHES W.G. AND OVER

- A. Install hangers for ducts as specified in the SMACNA Manual, with the following exceptions:

1. Support rectangular ducts with welded seams, regardless of size, by means of trapeze hangers, framed all four (4) sides. Provide minimum 1 x 1 x 1/8 inch angle iron framing for duct having a maximum side dimension up to and including 36 inches in size. Install framing snug to all four (4) sides of duct.

3.5 UPPER HANGER ATTACHMENTS

A. General

1. Secure upper hanger attachments to structural steel or steel bar joists wherever possible.
2. Do not use drive-on beam clamps, flat bars or bent rods, as upper hanger attachments.
3. Do not attach hangers to steel decks which are not to receive concrete fill.
4. Do not attach hangers to precast concrete planks less than 2-3/4 inches thick.
5. Avoid damage to reinforcing members in concrete construction.
6. Metallic fasteners installed with electrically operated or powder driven tools may be used as upper hanger attachments, in accordance with the SMACNA Manual, with the following exceptions:
 - a. Do not use powder driven drive pins or expansion nails.
 - b. Do not attach powder driven or welded studs to structural steel less than 3/16 inch thick.
 - c. Do not support a load, in excess of 250 lbs from any single welded or powder driven stud.
 - d. Do not use powder driven fasteners in precast concrete.

B. Attachment to Steel Frame Construction: Provide intermediate structural steel members where required by ductwork support spacing. Select steel members for use as intermediate supports based on a minimum safety factor of five (5).

1. Secure upper hanger attachments to steel bar joists at panel points of joists.
2. Do not drill holes in main structural steel members.

C. Attachment to Concrete Filled Steel Decks

1. New Construction: Install metal deck ceiling bolts.
2. Existing Construction: Install welding studs (except at roof decks).
3. Do not attach hangers to decks less than 2-1/2 inches thick.

D. Attachment to Hollow Block or Hollow Tile Filled Concrete Decks

1. New Construction: Omit block or tile and pour solid concrete with cast-in-place inserts.
2. Existing Construction: Break out block or tile to access and install machine bolt anchors at highest practical point on side of web.

E. Attachment to Wood Construction

1. Secure strap hangers to the sides of wood beams with one (1) No. 18 x 1-1/2 inch long

(minimum) wood screws or two (2) No. 16 x 1-1/2 inch long (minimum) drive screws. Do not hammer in wood screws.

2. Secure rod hangers to angle iron clip angles, bolted or screwed to the sides of the wood beams with 3/8 inch bolts or 3/8 inch lag screws. Install hanger rods with a threaded end through a hole in the angle, secured with a double nut, one (1) above and one (1) below the angle. Do not use lag screws in wood beams, having a nominal face width under 2 inches. Install bolts or lag screws in the side of beams at mid-point or above.
3. Pre-drill holes for lag screws 1/8 inch in diameter less than the root diameter of the lag screw thread.
4. Where wood trusses are approved to support ductwork, hangers may be attached only to the bottom chord. Method of attachment must be specifically approved.
5. Do not secure hanger attachments to nailing strips resting on top of steel beams.

3.6 DUCT RISER SUPPORTS, UNDER 2 INCHES W.G.

- A. Support vertical round ducts by means of double-ended split steel pipe riser clamps bearing on floor slabs or adjacent structural members, at every other floor through which the riser passes.
- B. Unless otherwise specified or shown on the drawings, support vertical rectangular ducts by means of two steel angles, secured to duct and resting on floor slab or adjacent structural steel member, at every other floor through which the duct passes. Size supports as follows:

MAX. SIDE DIMENSION (inches)	SUPPORT ANGLE (inches)	SECURE TO DUCT WITH	MIN BEARING AT EACH END (inches)
36	1 x 1 x 1/8	Screws	2
48	1-1/2 x 1-1/2 x 1/8	Bolts	3
60	2 x 2 x 1/8	Bolts	3
61 - up	2-1/2 x 2-1/2 x 3/16	Bolts	4

3.7 DUCT RISER SUPPORTS, 2 INCHES W.G. AND OVER

- A. Support vertical round ducts by means of double-ended split steel pipe riser clamps welded to the ducts and bearing on floor slabs or adjacent structural members, at every other floor through which the riser passes.
- B. Support vertical rectangular ducts by means of two steel angles or channels, anchor bolted to floor slab or adjacent structural member at every other floor through which the riser passes. Secure steel angles or channels to a transverse joint by means of 3/8 inch bolts, or by welding. Size supports as follows:

MAXIMUM SIDE DIMENSION (inches)	SUPPORT ANGLE (inches)	SUPPORT CHANNEL (inches)	MINIMUM BEARING AT EACH END (inches)
36	1 x 1 x 1/8	1 x 1/2 x 1/8	2
48	1-1/2 x 1-1/2 x 1/8	1-1/2 x 3/4 x 1/8	3
60	2 x 2 x 1/8	2 x 1 x 1/8	3
61 - up	2-1/2 x 2-1/2 x 3/16	2 x 1 x 3/16	4

3.8 VIBRATION ISOLATION FOR DUCTWORK

- A. Install vibration isolation in accordance with the manufacturer's printed installation instructions, unless otherwise specified.
- B. Install in locations shown or scheduled on the Drawings.
- C. High Velocity Ductwork Installed within Mechanical Equipment, Machine and Penthouse Mechanical Equipment Rooms: Provide combination rubber and spring type isolators, designed for insertion in a split hanger rod for overhead supported ductwork and double rubber-in-shear isolators for floor supported ductwork. Provide isolators designed for a static deflection of 1/2 inch.

3.9 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state, and local requirements, referenced standards, and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.
- C. Cleanliness
 - 1. Before installing ductwork, wipe ductwork to a visibly clean condition.
 - 2. During construction, provide temporary closures of metal or taped polyethylene on open ductwork and duct taps to prevent construction dust or contaminants from entering ductwork system. Seal ends of ductwork prior to installation to keep ductwork interior clean. Remove closures only for installation of the next duct section.
 - 3. During duration of construction, maintain the integrity of all temporary closures until air systems are activated.
 - 4. Provide openings in ductwork where required to accommodate thermometers, controllers, and other devices. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring. Sleeve of pitot tube opening shall be no more than one inch long. Opening shall be one inch wide to accept pitot tube.
 - 5. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
 - 6. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.
 - 7. Provide residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for cleanout. Use polished stainless steel for ductwork exposed to view and mill stainless steel for ducts where concealed.
 - 8. All visible welds in ductwork between biosafety cabinets, canopy hoods and fume hoods and the ceiling shall be ground and polished.
 - 9. Slope duct toward grilles for moisture-laden ducts. Provide drain and trap at elbow of main moisture exhaust duct system.

D. Grease Duct

1. All grease duct and components shall meet the requirements of NFPA 96 and the Mechanical Code.
2. The minimum requirements for access doors shall be as follows:
 - a. Label all access doors
 - b. Access doors shall be provided at sides or top of the duct, whichever is more accessible.
 - c. Provide access doors at all changes in direction.
 - d. On horizontal ducts at least one opening shall be provided for personnel entry (20"x20"). Where an opening of this size is not possible, openings large enough to permit cleaning shall be provided at a maximum of 12 foot intervals.
 - e. Where personnel entry is not possible, adequate access for cleaning shall be provided at each floor.
3. Slope all grease duct back to the hood / equipment served.
4. Install ducts with proper clearance to combustible and limited-combustible materials. Furnish and install listed duct insulation material when required to provide proper enclosure of ductwork. Include removable sections of insulation around duct access doors. Include an "Access Door" label.

E. Dryer Exhaust Duct

1. All dryer exhaust duct, terminations, and components shall meet the requirements of the Mechanical Code.
2. Do not fasten supports to ductwork with screws or fasteners that penetrate and protrude into the ductwork.
3. Provide fire-stopping around duct penetration in fire-resistance-rated walls or provide a noncombustible wall receptacle for clothes dryer exhaust duct connections.
4. Install an exterior termination approved for use with dryer exhaust applications. Provide with a gravity backdraft damper to prevent debris and pest intrusion. Do not install any mesh screens, cages, grids, or bars over the outlet termination.
5. Exterior termination shall be installed not less than 3 feet in any direction from doors, windows, outside air intakes, attic soffit vents, or any other building openings.
6. For installations of ductwork exceeding 35 feet of equivalent length, install a permanently label within 6 feet of the equipment duct connection that lists the installed installed equivalent length.

F. Hangers and Supports

1. All ductwork supports shall be in accordance with Table 4-1 (rectangular duct) and Table 4-2 (round duct) of the SMACNA Standards, with all supports directly anchored to the building structure.
2. Rectangular duct shall have at least one pair of supports on minimum 8'-0" (eight feet) centers. All horizontal round and flat oval ducts shall have ducts hangers spaced 10'-0" (ten feet) maximum.

3. Lower attachment of hanger to duct shall be in accordance with Table 4-4 of the SMACNA Standards.
4. Vertical ducts shall be supported where they pass through the floor lines with 1-1/2 inch x 1-1/2 inch x 1/4 inch angles for duct widths up to 60 inches. Above 60 inches in width, the angles must be increased in strength and sized on an individual basis considering space requirements.
5. Hanger straps on duct widths 60 inches and under shall lap under the duct a minimum of 1 inch and have minimum of one fastening screw on the bottom and two on the sides.
6. Hanger straps on duct widths over 60 inches shall be bolted to duct reinforcing with 3/8 inch bolts minimum.

3.10 DUCTWORK SYSTEM CLEANING

- A. If the system has been operated without schedule filters or if the integrity of temporary closures has been compromised, Contractor shall have ductwork cleaned according to National Air Duct Cleaners Association (NADCA) Standards by a Certified Regular Member of the NADCA.
- B. For ductwork supplying Clean Rooms or patient care areas, also sanitize the ductwork interior per NADCA standards with a biocidal agent approved by the EPA for use in HVAC systems.
- C. Before turning the installation over to the Owner, Contractor shall certify that the air handling systems have only been operated with scheduled filters in place. Otherwise, Contractor shall present evidence that the ductwork cleaned as required above.

3.11 TESTING

- A. A minimum of 25% of all medium and high pressure duct systems (positive or negative) shall be pressure tested according to SMACNA test procedures (HVAC Air Duct Leakage Test Manual) and ASHRAE Standard 90.1 requirements. The ductwork to be tested shall be 25% of the lineal feet of ductwork mains starting at the air handling unit or fan.
 1. Notify Owner minimum seven (7) calendar days in advance of leakage testing.
 2. Design pressure for testing ductwork shall be determined from the maximum pressure generated by the fan at the nominal motor horsepower selected.
 3. Total allowable leakage shall not exceed 1 percent of the total system design airflow rate.
 4. When partial sections of the duct system are tested, the summation of the leakage for all sections shall not exceed the total allowable leakage.
 5. Leaks identified during leakage testing shall be repaired by:
 - a. Complete removal of the sealing materials.
 - b. Thorough cleaning of the joint surfaces.
 - c. Installation of multiple layers of sealing materials.
 6. The ductwork system to be tested, shall exclude connections downstream of the terminal units (i.e., ductwork shall be capped immediately prior to the terminal units, and tested as described above).

7. After testing has proven that ductwork is installed and performs as specified, the terminal units shall be connected to ductwork and connections sealed with extra care. Contractor shall inform the Owner when joints may be visually inspected for voids, splits, or improper sealing of the joints. If any leakage exists in the terminal unit connections/joints after the systems have been put into service, leaks shall be repaired as specified for other leaks.
- B. All low-pressure duct systems (positive or negative) shall be inspected for visible and audible signs of leakage.
- C. Leaks identified by inspection shall be repaired by
 1. Complete removal of the sealing materials.
 2. Thorough cleaning of the joint surfaces.
 3. Installation of multiple layers of sealing materials.
- D. Discrepancies found during testing and balancing between duct traverses and diffuser/grille readings shall result in re-inspection, repair and retest until discrepancies are eliminated.
- E. Ductwork leakage testing and/or inspection shall be performed prior to installation of external ductwork insulation.

END OF SECTION

SECTION 23 3300 - DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the ductwork accessories indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Equipment Included in This Section
 - 1. Airflow Control Dampers and Spin-In Fittings
 - 2. Flexible Duct
 - 3. Flexible Duct Elbow Supports
 - 4. Flexible Duct Connections
 - 5. Duct Access Doors
 - 6. Screens
 - 7. Duct Test Holes
 - 8. Turning Vanes
 - 9. Remote Balancing Dampers
 - 10. Pressure Relief Doors

1.2 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. AMCA 500D – Laboratory Method of Testing Dampers for Rating
 - 2. AMCA 500L – Laboratory Method of Testing Louvers for Rating
 - 3. NFPA 90A - Installation of Air Conditioning and Ventilating Systems
 - 4. NFPA 101 - Life Safety Code
 - 5. SMACNA - HVAC Duct Construction Standards

1.3 SUBMITTALS

A. Product Data

1. Provide product data for shop fabricated assemblies including, but not limited to, volume control dampers, duct access doors, and duct test holes. Provide product data for hardware used.

PART 2 - PRODUCTS

2.1 GENERAL

- #### **A.**
- All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.2 AIR FLOW CONTROL DAMPERS

A. Acceptable Manufacturers

1. Greenheck
2. Nailor Industries
3. Pottorff
4. Ruskin
5. Tamco
6. United Enertech
7. Louvers & Dampers, Inc.
8. NCA Manufacturing
9. Air Balance

- #### **B.**
- Furnish and install dampers where shown on the Drawings and wherever necessary for complete control of airflow, including all supply, return, outside air, and exhaust branches, "division" in main supply, return and exhaust ducts, and each individual air supply outlet. Where access to dampers through a permanent suspended ceiling (gypsum board) is necessary, the Contractor shall be responsible for the proper location of the access doors.

- #### **C.**
- Dampers larger than three (3) square feet in area shall be controlled by a self-locking splitter damper assembly.

- #### **D.**
- Volume damper blades shall not exceed 48 inches in length or twelve inches in width and shall be of the opposed interlocking type. The blades shall be of not less than No. 16 gauge galvanized steel supported on one-half inch diameter rust-proofed axles. Axle bearings shall be the self-lubricating ferrule type.

- E. Volume dampers and other manual dampers shall be carefully fitted, and shall be manually controlled by damper regulators as follows:
1. On exposed non-insulated ductwork the locking quadrant shall be made with a base plate of 16-gauge cold-rolled steel and a heavy die cast handle designed with a 3/8 inch bearing surface. A 1/4 inch-20 zinc plated wing nut shall firmly lock the handle in place.
 2. On exposed externally insulated ductwork the regulator shall be 4-1/4 inch diameter, for 1/2 inch rod, designed for use on duct with insulation thickness specified for duct, and shall have four (4) 3/16 inch holes provided to rivet or screw regulator to the duct surface. The flange that covers the raw edge of the insulation shall be high enough so that it slightly compresses the insulation and holds insulation in place. The handle shall be 3/8 inch above the flange, and shall easily turn without roughing up the insulation.
 3. On concealed ductwork above inaccessible ceilings, the regulator shall be 2-5/8 inch diameter chromium plated cover plate that telescopes into the base, for 1/2 inch rod. Regulator shall be cast into a box for mounting in ceilings. Base shall be 1-1/2 inch deep. The cover shall be secured by two (2) screws that can be easily removed for damper adjustment.
 4. Furnish and install end bearings for the damper rods on the end opposite the quadrant.
- F. Spin-in fittings may be used for duct taps to air devices and shall include dampers on all ducts to air devices (diffusers and grilles) even though a volume damper is specified for the air device. Spin-in fittings shall be similar to Flexmaster FLD with BO3 including a 2 inch build-out, nylon bushings, locking quadrant similar to Duro Dyne KR-3, and a 3/8 inch square rod connected to the damper with U-bolts. Spin-in fittings shall be sealed at the duct tap with sealant as specified herein. Determine location of spin-in fittings after terminal units are hung or after location of light fixtures are confirmed to minimize flexible duct lengths and sharp bends.

2.3 FLEXIBLE DUCTS

- A. Acceptable Manufacturers
1. Flexmaster U.S.A., Inc.
 2. McGill AirFlow LLC.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
 4. Thermaflex
- B. Insulated, Flexible Duct:
1. Certifications:
 - a. UL 181,
 - b. ETL Class 1
 - c. NFPA 90A and 90B
 - d. Greenguard
 2. Construction:
 - a. Single ply inner liner constructed of chlorinated polyethylene
 - b. Corrosion resistant galvanized steel core
 - c. Fibrous glass insulation with a minimum value of R-6.

- d. Polyethylene vapor barrier film
- 3. Pressure Rating: 6-inch wg positive and 2-inch wg negative
- 4. Maximum Air Velocity: 5000 fpm
- 5. Temperature Range: -10° F to 160° F
- 6. Flame spread rating less than 25
- 7. Smoke developed rating of less than 50

2.4 FLEXIBLE DUCT ELBOW SUPPORTS

- 1. Acceptable Manufacturers
 - a. Build Right Products - FlexRight
 - b. Thermaflex – FlexFlow Elbow
 - c. RPS - FlowRite
- 2. Construction
 - a. Universal-mount, 1-piece, fully adjustable, radius-forming brace to support 4-inch through 16-inch diameter flexible air ducts.
 - b. Classified: UL 2043.
 - c. Material: 100 percent recycled copolymer polypropylene.
 - d. Support Frame Radius: 8 inches.
 - e. Compliance for Flexible Duct Radius:
 - 1) SMACNA HVAC Duct Construction Standards.
 - 2) ASHRAE Advanced Energy Design Guides.
 - 3) ADC Flexible Duct Performance and Installation Standards.

2.5 FLEXIBLE CONNECTIONS

- A. Where ducts connect to equipment, flexible connections shall be made using “Flexmaster TL-M” or “Ventglas” fabric that is temperature-resistant, fire-resistant, waterproof, mildew-resistant and practically airtight, weighing approximately thirty ounces (30 oz.) per square yard.
- B. Material used outdoors shall be resistant to ultra-violet sunrays. There shall be a minimum of 1/2" slack in the connections, and a minimum of 2 1/2" inches distance between the edges of the ducts. This does not apply to air handling units with internal isolation. A more rugged flexible material that is resistant to ultra-violet rays needs to be used when connecting an exhaust fan or exhaust air plenum to ductwork.

2.6 DUCT ACCESS DOORS

- A. Acceptable Manufacturers
 - 1. Greenheck
 - 2. Kees
 - 3. Nailor Industries
 - 4. Pottorff

5. Ruskin
- B. Furnish and install in the ductwork, hinged rectangular, or round "spin-in" access doors to provide access to the following items:
1. Major changes of direction in horizontal ducts connected to cooking equipment hoods and vertical grease duct risers as required by code for system cleaning. Refer to NFPA 96 and Specification Section 233113 for additional requirements.
 2. Motor operated dampers.
 3. Manually operated volume control devices.
 4. Mixed air plenums
 5. In-line damper actuators installed in air stream.
 6. Heating coils (install upstream)
 7. Duct mounted humidifiers (upstream and downstream)
 8. Airflow stations
 9. Air filters replacement doors
 10. All locations where operating parts of any kind are installed in the ductwork and elsewhere as indicated on the plans.
- C. Access doors are not required, where a manually operated damper has an exposed damper regulator, with an indicating quadrant.
- D. Where ductwork is insulated, access doors shall be double skin doors with 1" of insulation in the door.
- E. Door Size
1. Door opening shall be adequately sized and positioned to allow for maintenance / replacement of any components located inside the ductwork. Based on the maximum duct dimension the following access door size minimum requirements are as follows:
 - a. 8" max duct dimension - One (1)-Hand or Inspection Access: 8" x 6" access door
 - b. 12" max duct dimension - Two (2)-Hand Access: 12" x 10" or 10" diameter access door
 - c. 18" max duct dimension - Head and Hand Access: 16" x 12" or 16" diameter access door
 - d. 26" max duct dimension - Head and Shoulders Access: 24" x 16" or 22" diameter access door
 - e. 30" max duct dimension - Body Access: 26" x 14" or 24" diameter access door
 - f. All other sizes - Body plus Ladder Access: 26" x 18" or 26" diameter access door
 2. For duct access doors smaller than 16" x 12" Ventlok No. 90 sash style latches shall be used. For duct access doors 16" x 12" or larger Ventlok No. 260 latches shall be used.
 3. A minimum of two latches are required for all access doors are required. Provide additional latches as needed to ensure the access door is sealing properly and there is not noticeable air leakage or air noise associated with the access door.

- F. All access doors shall have a continuous gasket.
- G. Round access doors shall be "Inspector Series" spin-in type door as manufactured by Flexmaster USA.
- H. Where access doors are installed above a gyp board ceiling, this Contractor shall be responsible for providing and installing a ceiling access door of adequate size to utilize the access door and position it in the proper location.

2.7 SCREENS

- A. Furnish and install screens on all duct, fan, etc., openings furnished by this Contractor which lead to, or are located outdoors.
- B. Screens shall be No. 16 gauge, 1/2" mesh in removable frame as noted on drawings. Mesh and frame to be galvanized steel or aluminum as noted on the drawings.
- C. Provide safety screens meeting OSHA requirements for protection of maintenance personnel on all fan inlets and fan outlets to which no ductwork is connected.

2.8 TURNING VANES

- A. Acceptable Manufacturers
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. METALAIRE, Inc.
 - 4. SEMCO Incorporated.
 - 5. Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. Contractor fabricated turning vanes are acceptable provided they meet the requirements in this section.
- E. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- F. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.9 REMOTE DAMPER OPERATORS

- A. Acceptable Manufacturers
 - 1. Pottorff; a division of PCI Industries, Inc.
 - 2. Ventfabrics, Inc.
 - 3. Young Regulator Company
 - 4. United Enertech
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Brass
- D. Cable: Stainless steel
- E. Wall-Box Mounting: Recessed, 3/4 inches deep Recessed, 2 inches deep Surface
- F. Wall-Box Cover-Plate Material: Stainless steel
- G. Coordinate the location of the wall box with Architect / Engineer prior to installation.
- H. Required Locations:
 - 1. Diffusers installed in hard ceilings.
 - 2. Where dampers are not accessible due to congested ceilings.

2.10 PRESSURE RELIEF ACCESS DOOR

- A. Acceptable Manufacturers
 - 1. Greenheck
 - 2. Kees
 - 3. Pottorff
 - 4. Ruskin
- B. Door and Frame Material: Galvanized sheet steel.
- C. Door: Single wall Double wall with insulation fill with metal thickness applicable for duct pressure class.
- D. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
- E. Factory set at 3-inch wg
- F. Doors close when pressures are within set-point range.
- G. Hinge: Continuous piano.

- H. Latches: Cam.
- I. Seal: Neoprene or foam rubber.
- J. Insulation Fill: 1-inch-thick, fibrous-glass or polystyrene-foam board.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Volume Dampers
 - 1. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 2. Install steel volume dampers in steel ducts.
 - 3. Install aluminum volume dampers in aluminum ducts.
 - 4. Set dampers to fully open position before testing, adjusting, and balancing.
 - 5. Position damper adjacent to the branch connection to the main when possible. Locate as far as from the opening it serves in all other instances.
- D. Test Holes
 - 1. Install test holes at fan inlets and outlets and elsewhere as indicated.
 - 2. Install duct test holes where required for testing and balancing purposes.
 - 3. Install test holes in locations as required to measure pressure drops across each item in the system, e.g., outside air louvers, filters, fans, coils, intermediate points in duct runs, etc.
- E. Duct Access Doors
 - 1. Install duct access doors on sides or bottoms of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - a. On both sides of duct coils.
 - b. Upstream and downstream from duct filters.
 - c. At outdoor-air intakes and mixed-air plenums.
 - d. At drain pans and seals.

- e. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - f. At each change in direction and at maximum 50-foot spacing.
 - g. Upstream or downstream from duct silencers.
 - h. Control devices requiring inspection.
 - i. Elsewhere as indicated.
2. Install access doors with swing against duct static pressure.
3. Label access doors according to Division 23 Section "Mechanical Identification" to indicate the purpose of access door.

F. Flexible Connections

1. Install flexible connectors to connect ducts to equipment.
2. Flexible fabric connections installed at equipment exterior to the building shall be rated UV exposure and suitable for exterior use per ASTM G155 testing requirements. Metal for these connections shall be aluminum or stainless steel, galvanized connections shall not be allowed.
3. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment. Cover connections to medium and high pressure fans with leaded vinyl sheet, held in place with metal straps.
4. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

G. Flexible Duct

1. Connect terminal units to supply ducts directly or with maximum 36-inch lengths of flexible duct. Do not use flexible ducts to change directions.
2. Fittings on terminal units and on sheet metal duct shall have flexible duct core slipped over duct and coupling or clamp tightened, then connection sealed with sealant. Insulation of flexible duct shall be slipped over connection to point where insulation abuts terminal unit or insulation on duct.
3. These insulation connections shall be sealed by embedding fiberglass tape in the sealant and coating with more sealant to provide a vapor barrier.
4. The terminal ends of the duct core shall be secured by compression coupling or stainless steel worm gear type clamp.
5. Connect diffusers to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
6. Support flexible ducts as per SMACNA standards to prevent sags, kinks and to have 90 degree turns.

H. Flexible Duct Elbow Supports

1. Install flexible duct elbow supports in accordance with manufacturer's instructions.

2. Install flexible duct elbow supports over outer jacket of flexible ducts to form smooth, 90-degree bends to eliminate flexible duct kinks and airflow restrictions.
 3. Make bends in flexible ducts with minimum of 1-duct diameter centerline radius.
 4. Install flexible duct elbow supports at flexible duct 90-degree bends at following locations:
 - a. Diffusers.
 - b. Grilles.
 - c. Registers.
 - d. Duct take-offs and taps.
 - e. Air devices with round inlets and outlets.
 - f. HVAC equipment with round inlets and outlets.
 - g. As indicated on the Drawings.
- I. Balancing Dampers
1. Provide balancing dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing.
 2. Provide all dampers furnished by the BAS Provider in strict accordance with manufacturer's written installation instruction and requirements of these Specifications.
- J. Backdraft Dampers
1. Provide backdraft dampers on exhaust fans or exhausts ducts where indicated. Install dampers so that they will open freely.
- K. General Installation
1. All installation shall be in accordance with manufacturer's published recommendations.
 2. Furnish and install Ventlok No. 699 instrument test holes in the return air duct and in the discharge duct of each fan unit.
 3. Access doors as specified elsewhere shall be provided for access to all parts of the fire and combination fire and smoke dampers. Doors shall open not less than 90 degrees following installation and shall be insulated type where installed in insulated ducts.

END OF SECTION

SECTION 23 3425 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all work required to provide and install the Power Ventilators indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Equipment Included in This Section:
 - 1. Centrifugal roof ventilators.

1.2 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings
 - 2. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings
 - 3. AMCA 99 - Standards Handbook
 - 4. ACMA 203 - Fan Application Manual - Field Performance Measurements
 - 5. AMCA 204 - Balance Quality and Vibration Levels For Fans
 - 6. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
 - 7. AMCA 300 - Reverberant Room Method for Sound Testing of Fans
 - 8. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data
 - 9. NEMA MG1 - Motors and Generators
 - 10. NFPA 70 - National Electrical Code
 - 11. SMACNA - HVAC Duct Construction Standards - Metal and Flexible
 - 12. UL 705 – Power Ventilators

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 - 1. Certified fan performance curves with system operating conditions indicated

2. Certified fan sound-power ratings
 3. Motor ratings and electrical characteristics, plus motor and electrical accessories
 4. Material thickness and finishes, including color charts
 5. Dampers, including housings, linkages, and operators
 6. Roof curbs
 7. Fan speed controllers
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Wiring Diagrams: Power, signal, and control wiring.
 2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
- C. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal. The sound power levels must not exceed those indicated on Drawings.
- D. Fabrication: Conform to AMCA 99.
- E. Performance Base: 50 feet above sea level.
- F. Fans shall be capable of operating stably at reduced loads imposed by means of variable speed drives.
- G. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- H. UL Standard: Power ventilators shall comply with UL 705.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.6 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acme
 - 2. Twin City
 - 3. Greenheck
 - 4. Loren Cook Company.
 - 5. Pennbarry
 - 6. Soler & Palau
 - 7. Captiveaire
- C. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- D. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
 - 1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains and grease collector.
 - 2. Hinged Sub-base: Galvanized-steel hinged arrangement permitting service and maintenance.

- E. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- F. Accessories
 - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 - 2. Disconnect Switch: Non-fusible type, with thermal-overload protection mounted inside outside fan housing, factory wired through an internal aluminum conduit.
 - 3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
 - 4. Gravity Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
- G. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch-thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
 - 1. Configuration: Self-flashing for membrane roofs; with built-in cant for bituminous or built-up roofs
 - 1. General exhaust fan roof curb Height: Minimum 12 inches above finished roof level. Contractor to field coordinate required curb height based on roof insulation thickness.
 - 2. Grease exhaust fan roof curb height: Minimum 18" above finished roof level. Contractor to field coordinate required curb height based on roof insulation thickness.
 - 3. Pitch Mounting: Manufacture curb for roof slope.
 - 4. Metal Liner: Galvanized steel.
 - 5. Mounting Pedestal: Galvanized steel with removable access panel.
 - 6. Vented Curb: Unlined with louvered vents in vertical sides.
- H. Capacities and Characteristics:
 - 1. As scheduled on Drawings

2.2 MOTORS

- A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

2.3 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.
- C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- D. Install units with clearances for service and maintenance.
- E. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and verify connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust damper linkages for proper damper operation.
 - 6. Verify lubrication for bearings and other moving parts.
 - 7. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.

8. Shut unit down and reconnect automatic temperature-control operators.
 9. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- C. Replace fan and motor pulleys as required to achieve design airflow.
- D. Lubricate bearings.

END OF SECTION

SECTION 23 3700 – AIR INLETS AND OUTLETS

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the air inlets and outlets indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Equipment Included in This Section:
 - 1. Grilles, Registers and Diffusers

1.2 REFERENCES

- A. Equipment and Installation shall meet the requirements outlined in the following references:
 - 1. ACGIH: American Conference of Governmental Industrial Hygienists
 - 2. AMCA: Air Movement and Control Association
 - 3. NFPA: National Fire Protection Association
 - 4. SMACNA: Sheet Metal and Air Conditioning Contractors National Association, Inc.
 - 5. UL: Underwriters Laboratories, Inc.
 - 6. AMCA 500 – Test Method for Louvers, Dampers and Shutters
 - 7. ANSI/NFPA 90A – Installation of Air Conditioning and Ventilating Systems
- ASHRAE 70 – Method of Testing for Rating the Air Flow Performance of Outlets and Inlets

1.3 SUBMITTALS

- A. Product Data: (For Each Product)
 - 1. Catalog cut-sheets
 - 2. Indicate materials of construction, finish and mounting details
 - 3. Mounting details
 - 4. Installation instructions
 - 5. Performance data (at actual operating conditions)
 - a. Throw and drop
 - b. Static-pressure drop
 - c. Noise ratings

6. Inlet and Outlet Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

- B. Submit color and finish samples for all louvers.

1.4 QUALITY ASSURANCE

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. Grilles, registers and diffusers shall be as scheduled on the Drawings. Grilles, registers and diffusers shall be provided with sponge rubber or soft felt gaskets where noted on the Drawings. Grilles, slot diffusers and laminar flow bars shall not be internally insulated.
- C. If a manufacturer other than the one scheduled is used, the sizes shown on the Drawings shall be checked for performance, noise level, face velocity, throw, pressure drop, etc., before the submittal is made. Selections shall meet the manufacturer's own published data for the above performance criteria. The throw shall be such that the velocity at the end of the throw in the five (5) foot occupancy zone will not exceed 50 fpm or be less than 25 fpm except where indicated otherwise. Noise levels shall not exceed those published in ASHRAE for the type of space being served (NC level).
- D. Locations of air distribution devices on Drawings are approximate and shall be coordinated with other trades to make symmetrical patterns and shall be influenced by the established general pattern of the lighting fixtures or architectural reflected ceiling plan, but primarily located to maintain proper air distribution. Where called for on Drawings, grilles, registers and diffusers shall be provided with deflecting devices and manual dampers. These grilles, registers, and diffusers shall be the standard product of the manufacturer, and subject to review by the Architect.
- E. Provide a frame compatible with the type of ceiling or wall in which the devices are installed. Refer to Architectural Drawings for exact type of ceiling specified.
- F. Coordinate color and finish of the devices with the Architect.

PART 2 - PRODUCTS

2.1 GRILLES, REGISTERS, AND DIFFUSERS

- A. Acceptable Manufacturers
 1. Anemostat
 2. Carnes
 3. Krueger
 4. Nailor
 5. Price
 6. Titus

7. Tuttle & Baily

B. Square Panel Face diffuser – Supply and Return

1. Architectural diffuser with a square panel face, centered within a square housing. The exposed surface of the face panel shall be smooth, flat and free of visible fasteners.
2. The diffuser shall have a 22-gauge steel face panel that captures a secondary 22-gauge panel. The panel shall project a maximum of 1/4" below the outside border of the diffuser.
3. For area of high moisture content or requiring non-ferrous materials, the diffuser shall be constructed of 22-gauge aluminum. This includes a 22-gauge aluminum panel that captures a secondary panel.
4. The face panel size shall be a minimum of 18" x 18" for 24" x 24" diffusers and 9" x 9" for 12" x 12" diffusers.

C. Perforated Face Ceiling Diffusers – Supply

1. Perforated face with fully adjustable pattern and removable face.
2. Perforated face to consist of 3/16" diameter holes on 1/4" staggered centers. A minimum of 51% free area shall be available.
3. Fabricate completely of 22-gauge steel with a baked enamel off-white finish.
4. The diffuser shall have a 22-gauge steel face panel that captures a secondary 22-gauge panel. The panel shall project a maximum of 1/4" below the outside border of the diffuser.
5. For areas of high moisture content or requiring non-ferrous materials, the diffuser shall be constructed of 22-gauge aluminum.
6. Provide multi-louvered equalizing grid where noted on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

1. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
2. All installation shall be in accordance with manufacturer's published recommendations.

B. Diffusers

1. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, reflected ceiling plans, symmetry, and lighting arrangement.

2. Install air outlets and inlets to ductwork with airtight connection.
3. Provide balancing dampers on duct take-off to diffusers, grilles and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.
4. Provide all specialties and frames for air distribution devices as required for proper installation in ceiling type as indicated on Architectural Drawings. Provide all cutting and patching of T-bars, gypsum board, and other ceiling systems as required for installation of air devices.

C. Special Requirements

1. Paint ductwork visible behind air outlets and inlets matte black. Refer to Division 09.

END OF SECTION

SECTION 23 3725 - KITCHEN HOODS

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the air inlets and outlets indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Equipment Included in This Section:
 - 1. Type I Commercial Kitchen Hoods
 - 2. Fire Suppression Systems
 - 3. Control Systems
 - 4. Lighting

1.2 REFERENCES

- A. Equipment and Installation shall meet the requirements outlined in the following references:
 - 1. AMCA: Air Movement and Control Association
 - 2. NFPA: National Fire Protection Association
 - 3. SMACNA: Sheet Metal and Air Conditioning Contractors National Association, Inc.
 - 4. UL: Underwriters Laboratories, Inc.
 - 5. ANSI/NFPA 90A – Installation of Air Conditioning and Ventilating Systems
 - 6. ASHRAE 70 – Method of Testing for Rating the Air Flow Performance of Outlets and Inlets

1.3 SUBMITTALS

- A. Product Data:
 - 1. Standard hoods.
 - 2. Filters/baffles.
 - 3. Fire-suppression systems.
 - 4. Lighting fixtures.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer.
 - 1. Show plan view, elevation view, sections, roughing-in dimensions, service requirements, duct connection sizes, and attachments to other work.

2. Show cooking equipment plan and elevation to confirm minimum code-required overhang.
3. Indicate performance, exhaust and makeup air airflow, and pressure loss at actual Project-site elevation.
4. Show control cabinets.
5. Show fire-protection cylinders, piping, actuation devices, and manual control devices.
6. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
7. Design Calculations: Calculate requirements for selecting seismic restraints.
8. Wiring Diagrams: Power, signal, and control wiring.
9. Piping Diagrams: Detail fire-suppression piping and components and differentiate between manufacturer-installed and field-installed piping. Include roughing-in requirements for drain connections. Show cooking equipment plan and elevation to illustrate fire-suppression nozzle locations.
10. Installing fire suppression contractor shall submit the Engineer/Owner approved shop drawings and project plans to the State Fire Marshal for final approval prior to installation.

1.4 QUALITY ASSURANCE

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. Coordinate color and finish of the devices with the Architect.
- C. Coordinate trim pieces and skirts required around the hood to match the actual space conditions.

1.5 DEFINITION

- A. Listed Hood: A hood, factory fabricated and tested for compliance with UL 710 by a testing agency acceptable to authorities having jurisdiction.
- B. Type I Hood: A hood designed for grease exhaust applications.

PART 2 - PRODUCTS

2.1 TYPE I HOODS

- A. Acceptable Manufacturers
 1. Captive Aire
 2. Greenheck

3. Halton

B. Construction

1. Shall be type 430 stainless steel with a #3 or #4 polish, where exposed.
2. The manufacturer and ETL shall determine individual component construction. Construction shall be dependent on the structural application to minimize distortion and other defects.
3. All seams, joints and penetrations of the hood enclosure to the lower outermost perimeter, which directs and captures grease-laden vapor and exhaust gases, shall have a liquid-tight continuous external weld in accordance with NFPA 96.
4. Hood shall be wall type with a minimum of four connections for hanger rods. Corner hanging angles have a 5/8" x 1-1/2" slot pre-punched at the factory, allowing hanging rods to be used for quick and safe installation.
5. Ventilator shall be furnished with U.L. classified high efficiency stainless steel baffle filters, supplied in size and quantity as required by ventilator. The filters shall extend the full length of the hood and the filler panels shall not be more than 6" in width.
6. Exhaust duct collar to be 4" high with 1" flange. Duct sizes, CFM and static pressure requirements shall be as shown on drawings. Static pressure requirements shall be precise and accurate; air velocity and volume information shall be accurate within 1-ft increments along the length of the ventilator.
7. The hood shall have:
 - a. A double wall insulated front to eliminate condensation and increase rigidity on 30"-36" wide sizes. The insulation shall have a flexural modulus of 475 EI, meet UL 181 requirements and be in accordance with NFPA 90A and 90B.
 - b. An integral baffle to direct grease laden vapors toward the exhaust filter bank.
 - c. Removable grease cup for easy cleaning.
8. The hood shall be ETL Listed as "Exhaust Hood Without Exhaust Damper", ETL Sanitation Listed and built in accordance with NFPA 96. The hood shall be listed for 450°F cooking surfaces at 150 CFM/ft and 600°F cooking surfaces at 200 CFM/ft.
9. All seams shall be welded and have stainless steel on exposed surfaces.
10. Perforated diffuser plates shall be included in the design, to provide even air distribution.
11. Unexposed surfaces shall be constructed of aluminized steel.
12. Plenum shall be insulated to prevent condensation.
13. Accessories
 - a. Utility Cabinet
 - b. Enclosure Panels
 - 1) Backsplash
 - 2) Right and left end panels
 - 3) Field wrapper (front, left, right)

14. Fire Suppression System

- a. Acceptable Manufacturers
 - 1) Iowa Fire Equipment Company
 - 2) Captive Aire
 - 3) Greenheck
 - 4) Halton
- b. Ansul fire suppression system
- c. Pre-piped in hood utility cabinet to discharge nozzles
- d. Includes the following components:
 - 1) Tank
 - 2) Detection
 - 3) Release mechanism
 - 4) Micro switches
 - 5) Pull station

15. Lighting and Power

- a. U.L. incandescent light fixtures with clear thermal & shock resistant globes. Lights shall be installed and pre-wired to a junction box.
- b. The light fixtures shall be installed with a maximum of 4'-0" spacing on center and allow up to a 100 watt standard light bulb.
- c. Unit mounted light switch

16. Controls

- a. Provide hood with a unit mounted controller that includes the following functions:
 - 1) Exhaust fan control
 - 2) Lighting control
 - 3) Duct mounted temperature sensor
 - 4) Room temperature sensor
 - 5) Interlock with fire suppression system
 - 6) Interlock with fire alarm / building automation system
- b. Duct mounted temperature sensor shall activate the exhaust fan (on/off) based on differential between duct temperature and room temperature. Controller shall also allow for manual operation of the fan and lighting controls.
- c. During fire mode, unit mounted controller to operate exhaust fan and turn off the lights. Include a relay to interface with fire alarm system to turn supply airflow to the space off during fire mode.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

- 1. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- 2. All installation shall be in accordance with manufacturer's published recommendations.

3. Equipment start-up shall be performed in the presence of the equipment vendor and installing fire suppression contractor.

END OF SECTION

SECTION 23 7415 – ROOFTOP AIR HANDLING UNITS (3-27.5 TONS)

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the following Rooftop Air Handling Units indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Equipment Included in this Section
 - 1. Gas Fired, DX Cooling, Rooftop Units

1.2 REFERENCES

- A. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed withing the following references:
 - 1. AMCA, ANSI, ARI, ASTM, and NEC standards and codes applicable to rooftop air handling units.
 - 2. ASHRAE 90.1 – Energy Standard for Buildings Except Low High Rise Residential Buildings
 - 3. ASHRAE 52.2 – Method of Testing General Ventilation Air-Cleaning Devices Used for Removal Efficiency
 - 4. ANSI/ASHRAE Standard 135 BacNet – A Data Communication Protocol for Building Automation and Control Network
 - 5. NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems.

1.3 SUBMITTALS

- A. Product Data
 - 1. Provide literature that indicates dimensions, weight, loading, clearances, capacities, gauges, thickness, and finishes of materials electrical characteristics and connections.
 - 2. Rigging, installation, testing, start-up and operating instructions, maintenance data including type and quantity of oil and refrigerant change (pounds), parts lists, and troubleshooting guide.
 - 3. Data on energy input versus cooling load output from 100 percent to 20 percent of full load with constant entering condenser air temperature. Data on heating input, heating output, and AFUE values.
 - 4. Information about control and wiring diagrams.
 - 5. Product test data on sound power levels for both fan inlet and outlet at the rated design capacity.

6. Operating data such as fans speeds, compressor LRA and RA, sound levels
7. Product data on special condenser coating.
8. Product data on all condenser fans accessories such as controls.

1.4 QUALITY ASSURANCE

- A. The design of the unit shall be AGA and ARI certified as combination heating-cooling units for rooftop installation.
- B. Unit construction shall comply with ASHRAE 15 safety code, NEC, and UL applicable codes.
- C. Cooling capacity ratings shall be in accordance with ARI standards 210/240, most recent edition.
- D. Insulation and adhesive shall meet NFPA 90A requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, and protect and handle products to the Project Site under provisions of Division 01 and Division 20.
- B. Accept products on Site in factory-fabricated protective containers or coverings, with factory-installed shipping skids and lifting lugs. Inspect for damage.
- C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.
- D. Check and maintain equipment on monthly basis to ensure equipment is being stored in accordance with manufacturer's recommended practices. Storage record shall be maintained that indicates above requirements have been met.

1.6 EXTRA MATERIALS

- A. Provide an additional replacement set of filters.

1.7 WARRANTY

- A. Units shall be furnished with full coverage warranty against defects in materials. Warranty on the complete unit shall be for one (1) year from Substantial Completion date.
- B. Component Warranties from date of Substantial Completion
 1. Compressors: five (5) years
 2. Controls: three (3) years
 3. Heat Exchangers: ten (10) years
 4. Other System Components: eighteen (18) months

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. CaptiveAire– Paragon
- B. Trane – Precedent (3-10 tons)
- C. Trane – Voyager 2 (12.5-25 tons)
- D. Daikin – Rebel (3-28 tons)
- E. Carrier – Weatherexpert (3-23 tons)
- F. York – Predator (3-12.5 tons)

2.2 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. The packaged unit shall perform to manufacturer's product data, installation instructions, start-up instructions and maintenance information indicated by all Specification Sections, and Contract Documents with supplementary items necessary for proper operation.
- C. Air cooled unit shall consist of hermetic scroll compressor component utilizing R-410A, evaporator coil, air-cooled condenser coil, condenser fans, supply fan, vibration isolation assemblies, and microprocessor control center.
- D. Factory assembled air-cooled packaged DX air conditioning unit using a refrigerant charge (R454B) with the following construction:
 - 1. Factory control and electrical wiring and piping shall be contained within the unit cabinet.
 - 2. Access doors with galvanized or thermoplastic hinges and lockable handles.
 - 3. Compressors and unit controls contained within single isolated compartment.
 - 4. Scroll compressors installed on sheet metal deck with rubber isolation mounts for quiet efficient operation.
 - 5. Compressor isolation valves.
 - 6. DX evaporator coil(s).
 - 7. Stainless steel gas heat exchanger
 - 8. Fan motors
 - 9. Direct drive condenser fan(s).
 - 10. Bottom return and supply air

11. Roof sloped for proper drainage
 12. Single point power connection
 13. Thermostatic expansion valves on DX coils
 14. Manual reset high pressure cutoffs
 15. Automatic reset low pressure cutoffs
 16. Refrigerant leak detection system
 17. Run test report, wiring diagram, installation manual and start-up form in control access compartment.
 18. 120 v, 15a powered GFI convenience outlets.
- E. Optional equipment as indicated on the Drawings
1. Power exhaust fan and economizer
 2. Smoke detectors in return and/or supply air
 3. Phase and brown-out protection
 4. Disconnect switch
 5. Humidity control
- F. Compressor shall have load capacity ratings per the requirements ARI 210/240.
- G. Unit efficiency shall be in compliance with the requirements of the International Energy Conservation Code ASHRAE 90.

2.3 CABINET AND INSULATION

- A. G90 galvanized cabinet.
- B. The cabinet housing shall be constructed of heavy gauge galvanized steel framework covered with galvanized steel sheet casing. Casing metal shall be finished with weather-resistant finish paint.
- C. Refrigeration components and compressor shall be accessible through removable louvered panels as standard. All access doors and panels shall have neoprene gaskets.
- D. Unit base shall be watertight with heavy gauge formed load bearing members and curb overhang.
- E. Provide steel lifting lugs to allow placement of the unit using a crane and sling.
- F. The weatherproof cabinet of the indoor air section shall have thermal breaks to prevent condensation on any cabinet surface exposed to outside atmosphere conditions.

- G. If the unit is not placed on a roof, make provisions to elevate and support the unit off the ground or grade level to protect unit from standing in water.

2.4 COMPRESSORS

- A. Each scroll compressor shall be fitted with low ambient crankcase heater, vibration isolators, refrigerant dryer, external connections for external oil level control if multiple compressors are required, motor winding protection, high and low pressure cutouts, plus any other protective or operating device or fitting required and provided as standard by the compressor manufacturer. Compressors shall be designed for continuous or cycling operation at the specified design conditions without detrimental effect.
- B. Each compressor shall be industrial grade, energy efficient direct drive scroll type. The motor shall have a suction gas cooled hermetic design. Compressor shall have oil sight glass and oil charging valve. Crankcase heaters will be standard on each compressor to minimize amounts of liquid in the oil sump when unit is off.
- C. Provide with thermostatic motor winding temperature control to protect against excessive motor temperatures resulting from over-/under-voltage or loss of charge. Provide high and low pressure cutouts, and reset relay.
- D. Provide factory installed compressor lockout thermostat to prevent compressor operation at low ambient conditions.
- E. Provide coil frost protection compressor unloading based on refrigerant circuit suction temperature to prevent coil frosting with minimum energy usage.
- F. Provide replaceable core, liquid line filter dryers with refrigerant isolation valves. Dryer housings and isolation valves shall be located in the unit condenser section, and be easily accessible for routine service.

2.5 FANS, MOTORS AND DRIVES

- A. Indoor airflow and external static pressure capabilities shall be no less than the values indicated on the drawings. Internal static pressure shall include a minimum allowance for 2-inch pleated type filters.
- B. All fan(s) and motor(s) shall be in compliance with the fan power limitation in Table 6.5.3.1 of ASHRAE 90.1.
- C. Outdoor fans shall be direct drive, shaft mounted propeller type, statically and dynamically balanced. Outdoor fan motor(s) shall be TEFC weather resistant with permanently lubricated bearings.
- D. Indoor fan motor(s) shall be TEFC with sealed lubricated bearings. Indoor fans shall be statically and dynamically balanced and configured as listed below:
 - 1. 3-10 ton units: ECM direct drive, shaft mounted centrifugal type
- E. Provide airfoil type double width, double inlet supply fan(s) with fixed-pitch drive assemblies. Provide thrust restraint isolation on the fan housing/fan board to assure smooth fan startup transition and operation.

- F. Provide forward curved type, double width, double inlet exhaust fans with variable speed drive fixed-pitch drive assemblies.
- G. Provide plenum type with air foil blade, single width, single inlet relief fan with fixed-pitch drive assemblies. Dynamically balance all fans, and the unit's running fan assembly, or assemblies, (fan mounted on actual shaft, bearings, and in scroll housing for double width, double inlet fans) to assure smooth operation of the fans and associated assemblies. Balancing of the fan only shall not be acceptable.
- H. Mount fan motor(s) and fan(s) on a common base assembly and isolated from unit with 1" spring isolation.
- I. Fan shaft(s) shall be mounted on grease lubricated bearings (ball bearings for supply fan, ball or roller bearing for return/exhaust). Bearings shall be fitted with extended lubrication lines and lubrication ports external to the fan compartment(s) to facilitate ease of maintenance.

2.6 AIR FILTERS

- A. Front or side loaded filters shall be easily accessible for removal through access panels or doors.
- B. Filters shall match the performance information listed in the schedule on the drawings.
- C. Filter face velocity shall not exceed 350 fpm.

2.7 COILS – GENERAL

- A. Coils shall be standard construction copper tubes with aluminum fins. All copper work shall be brazed. Coils shall be factory pressure tested to 500 psi.
- B. Indoor coils shall be capable of the performance indicated on the drawings with no carry-over of condensate.
- C. Coils shall have a maximum fin spacing of 12 fpi.
- D. Coils shall have a maximum face velocity of 550 fpm.
- E. Indoor coils shall be equipped with a sloped, corrosion resistant condensate pan terminating at a condensate drain located outside the unit cabinet.

2.8 EVAPORATOR COILS

- A. Units smaller than 7.5 tons nominal capacity shall be required to have part-load/staged refrigeration capability. Each unit of 7.5 to 20 tons refrigeration capacity shall have variable speed compressors for modulating cooling control.
- B. The refrigeration system shall be equipped with filter dryers on the liquid lines and service valves with gauge port connections on the discharge and suction lines.
- C. Provide modulating hot gas reheat option consisting of hot gas reheat coil located on the leaving air side of the evaporator coil and pre-piped to circuit 1 along with a staged on/off reheat valve.

2.9 AIR-COOLED CONDENSER

- A. Provide heavy duty aluminum fins mechanically bonded to copper tubes.
- B. Provide subcooling circuit(s) integral with condenser coils to maximize efficiency and prevent premature flashing of liquid refrigerant, to a gaseous state, ahead of the expansion valve.
- C. Provide vertical discharge, direct drive, fans with steel blades, and three phase totally enclosed, air over cooled, motors. Fans shall be statically and dynamically balanced. Motors shall be permanently lubricated, with built-in current and thermal overload protection.
- D. Provide factory installed wire guards around perimeter of condensing section to protect the condenser coils, refrigerant piping and control components from damage resulting from hail, flying debris, and vandalism. Course wire mesh is not an acceptable material for coil guards.
- E. Condenser coils shall not exceed 13 fins per inch density in order to permit routine cleaning and prevent excessive air pressure drop across the coils.

2.10 GAS HEAT EXCHANGERS

- A. Units shall be equipped with a stainless steel natural gas burning heat exchanger of corrosion resistant components to provide efficient heating operation. Burner shall be designed for natural gas supply at 7-10' water column manifold pressure.
- B. Burner shall be equipped with electronic or spark ignition, flame sensor, manual shut-off, and A.G.A approved controls.
- C. The induced draft blower shall pre-purge and shall be provided with a proving switch to prevent burner operation if blower is not in operation.
- D. Units shall be equipped with modulating gas valves with turndown ratios as listed in the schedule on the drawings.
- E. A.G.A. thermal efficiency for the heat exchanger shall be minimum of 80 percent.
- F. Manual reset limit switch shall shutdown the burner in case operating controls fail.

2.11 DAMPERS

- A. Provide Class 2 low leakage dampers with airfoil blades, rated at 1" inches W.C. static pressure.
- B. Leakage rate shall be determined in accordance with AMCA Standard 500.

2.12 ELECTRICAL REQUIREMENTS

- A. The unit shall be designed for the electrical service designated on the drawings.
- B. Arrange electrical cabinet for connecting electrical service at one point only.
- C. Power and control wiring of the unit shall be factory installed complete within the unit. Provide correctly identified suitable lugs and terminal strips for field connection to electrical power and external controls.

- D. Factory equip unit with motor starters for each of the motor driven components.
- E. Factory equip with unit mounted variable frequency drives (VFD) or ECM motors located inside the unit cabinet. VFD's shall be completely pre-wired and ready for operation.

2.13 CONTROLS (CONSTANT VOLUME UNITS)

- A. Integrated Modular Control (IMC)
 - 1. Solid state control board to operate unit.
 - 2. Built-in functions include:
 - a. Blower on/off delay
 - b. Built-in control parameter defaults
 - c. Service relay output
 - d. Dirty filter switch input
 - e. Humidity control input
 - f. Single differential economizer control
 - g. Gas valve delay between stages
 - h. Unit diagnosis with code storage
 - i. CO2 level input
 - j. Low ambient controls
 - k. Minimum run time
 - l. Night setback mode
 - m. Smoke alarm mode
 - n. Low pressure control
 - o. Three (3)-digit display
 - p. Degrees F or degrees C display
 - q. Heating and cooling staging
- B. Provide wall mounted thermostat with back lit digital display. At a minimum thermostat shall be capable of setpoint adjustment, 5-1-1 day programming, unoccupied setback, and filter status. Thermostat may use pushbutton or touchscreen interface. Thermostat shall be manufactured by unit manufacturer or Honeywell.
- C. Gas Heating Controls
 - 1. Modulating heating control
 - 2. Supply fan to turn on after heating demand is received with an adjustable time delay.
 - 3. Supply fan to turn off after heating demand has ended with an adjustable time delay.
 - 4. Adjustable delay time between low and high fire of gas valve system.
 - 5. To turn off heat if induced airflow is too low.
 - 6. Error reported if gas valve not energized two (2) minutes after heating demand.
 - 7. Shut off gas valve if flame not sensed.
 - 8. Delay between stages on gas valve.
 - 9. To shut off unit if gas valve is energized with no demand for heat.

10. All errors reported.

D. Cooling Controls

1. Automatic outside air dampers for fixed outside air quantity. Remote controlled outside air dampers with damper operator and means for adjusting outside air quantity. Motorized outside, and Power exhaust relief dampers with spring return damper operator and control package to automatically vary outside air quantity. Outside air and exhaust air dampers, normally closed. Tight-fitting parallel blade dampers with neoprene or suitable gaskets, synthetic bushings and 1% maximum leakage. Damper Operation: 24 V, spring return motor with gear train sealed in oil. Mixed Air Controls: Maintain 55° F mixed air temperature (adjustable) Variable speed compressors for modulating cooling control
2. Adjustable blow on and off delay
3. Minimum compressor on time of five (5) minutes, adjustable between 1-8 minutes.
4. Maximum high and low pressure switch.

F. Condenser Fan Control: On units with multiple condenser fans, adjustable time delay between condenser fan shutoff and restart to prevent reverse rotation of fan.

G. The microprocessor controller provided by the equipment manufacturer shall be capable of receiving signals from a variety of control sources, which are not mutually exclusive. The control shall interface with the building automation system (BAS) via the BACNet interface panel. All variables listed in the points list shall be passed to the BAS via the gateway. Application specific controllers (ASC) shall communicate using protocol specified above. Equipment manufacturer shall include on-site programming assistance to both the Owner and BAS provider to: Assure that data from their respective interface is available. Assist the BAS Provider to establish proper communication. Confirm that the interface and controller are operating in accordance with sequence of operation. Provide software or hardware tools as required to operate and checkout the controller interface. Insulate all surfaces expected to be at or below a dew point temperature of 78° F to prevent condensation. **ACCESSORIES**

A. Roof Curb

1. Furnish one (1) complete roof curb for each packaged unit, designed for weatherproof installation. Curb shall be furnished approved by unit manufacturer.
2. Supply and return ducts shall connect through the curbed opening with flexible connections to the bottom of the A/C unit, unless shown otherwise on the drawings.
3. Curb shall comply with National Roofing Contractors Association requirements.
4. Slope of roof curb shall match roof slope to provide for level support of packaged unit.
5. Contractor shall be responsible for coordination of curb, supply and return ducts, and weatherproofing of the entire installation.

B. Outside air intake assembly, including low-leak dampers, weather hood and motorized open/closed actuators.

C. Units shall be equipped with economizer. Economizers shall include a fully modulating 100 percent outside air damper that is mechanically interlocked with a return air damper.

- D. Where designated on the drawings, units shall be equipped with a powered exhaust fan and necessary controls to prevent pressurization of the building during economizer operation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state, and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.
- C. Gas packaged air conditioning units shall be installed according to manufacturer's recommendations to be completely weatherproof. Protect the roof from damage during installation. Secure factory touch-up paint to repair scratches and minor damage to equipment prior to Start-up.
- D. Power wiring to the units, including externally mounted service disconnect switch, shall be furnished and installed under Division 26. Installing Contractor shall be provided with the manufacturer's Shop Drawings as required for power wiring installation.
- E. Controls for conditioned spaces shall be as required under Division 23, Building Automation System.

3.2 TESTING

- A. Equipment shall be cycled through all heating, cooling, and ventilation cycles to ensure proper operation of all components and controls prior to test and balance.
- B. At time of Start-up, manufacturer's representative shall visit the Project site and verify that unit installation and performance is satisfactory, and to make any adjustments or settings to unit operating and safety controls that may be required.
- C. Include Start-up checkout service of at least one (1) working day for one (1) service technician, including a written report of operational check provided to the owner. Owner's Representative may require that the Start-up service be performed with Owner's attendance and on-site review.
- D. Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- E. Clean filters shall be placed within the unit the time of Substantial Completion.

END OF SECTION

SECTION 23 7423 – MAKEUP AIR UNIT

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the makeup-air unit(s) indicated by the Contract Documents with supplementary items necessary for proper installation.

1.2 REFERENCES

- A. The adopted version of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. ANSI Standard Z83.8 (adopted version)/CSA 2.6 (adopted version) and shall bear the ETL label.
 - 2. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
 - 3. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
 - 4. AMCA 99 - Standards Handbook.
 - 5. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
 - 6. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
 - 7. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.
 - 8. AMCA 500 - Test Methods for Louver, Dampers, and Shutters.
 - 9. ARI 260 - Sound Rating of Ducted Air Moving and Conditioning Equipment
 - 10. NEMA MG1 - Motors and Generators.
 - 11. NFPA 70 - National Electrical Code.
 - 12. NFPA 90A – Flame and Smoke Spread Ratings.
 - 13. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
 - 14. UL 900 - Test Performance of Air Filter Units.
 - 15. ANSI/ASHRAE/IESNA Standard 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings

1.3 SUBMITTALS

- A. Product Data
 - 1. Catalog sheets, brochures, performance charts, standard schematic drawings, specifications and installation instructions for each air handling unit.
- B. Contract Closeout Submittals
 - 1. Operation and Maintenance Data as required in Section 230500.
- C. The supplier shall furnish gas piping schematics, as built wiring connection and control-circuit diagrams, dimension sheets and a full description of the unit(s). Service manuals, showing service and maintenance requirements, shall be provided with each unit.

1.4 QUALITY ASSURANCE

- A. Unit(s) shall be operated, tested and set at the factory using job-site conditions for electrical and gas input. All operating and safety controls shall be tested and set at the factory. Adjustable or fixed sheaves shall be set for proper RPM at specified conditions. Gas-pressure regulator shall be set for specified burning rate at specified inlet pressure.

1.5 WARRANTY

- A. Units shall be furnished with full coverage warranty against defects in materials. Warranty on the complete unit shall be for one (1) year from the Substantial Completion date.
- B. Component Warranties from date of Substantial Completion
 - 1. Compressors: five (5) years
 - 2. Controls: three (3) years
 - 3. Heat Exchangers: ten (10) years

PART 2 - PRODUCTS

2.1 GAS FIRED MAKEUP – AIR UNITS

- A. Acceptable Manufacturers
 - 1. AbsolutAire
 - 2. Airedale
 - 3. CaptiveAire
 - 4. Greenheck
 - 5. Rupp
 - 6. ThermoTek

7. Trane
 8. Hartzell
 9. Bananza
 10. Ares
- B. Modular Packaged Heating and ventilating units, as indicated on the drawings shall be furnished.
- C. Unit(s) shall be Direct Fired Gas, down discharge. Units shall be factory assembled, tested and shipped as a complete packaged assembly, for outdoor mounting.
- D. Makeup-air units shall consist of the following components
1. Gas burner
 2. DX cooling with unit mounted compressors / condensing units
 3. Supply fan, motor and drive assembly. Integral variable frequency drive to allow for fan speed modulation
 4. Filters
 5. Outside air intake hood, bird screen, insect screen, modulating damper and actuators
 6. Roof curb
 7. Access doors
 8. Stand alone controls with interface to the kitchen hood control system to operate the unit in conjunction with the hoods and exhaust fans. Unit will also include an interface with the building automation system for unit monitoring.
 9. Single-point electrical connection and safety controls
 10. Remote control panel
- E. Housing
1. Exterior metal panels to be G-90 galvanized steel or aluminum, 18 gauge minimum. Painted with high grade exterior finish, color selection by Architect. Assume color shall be white, off-white, or light tan for bidding purposes.
 2. All interior surfaces to be lined with 1" thick, 1-1/2 pound density foil-face fiberglass insulation.
 3. Floor and wall panels shall be caulked air tight with a silicone caulk. All casing panels shall be attached with sheet metal screws or rivets, which can be removed to field service large components.
 4. The unit base shall be suitable for curb.
 5. Housing construction should be suitable for outdoor installation

6. An observation port shall be located on the exterior of the unit for observation of the main flame and pilot flame.
7. All controls, gas valves, modulating controls and electrical components shall be mounted within the burner vestibule. The burner vestibule shall be an integral part of the unit and not extend outside the exterior casing of the unit and not exposed to the main air stream. The vestibule full-size door shall provide easy access to controls and gas-train components. Blower door shall provide easy access to blower, motor and drives.
8. Access doors shall be provided on both sides of unit providing full access to every part of the unit.

F. Base

1. The base shall be constructed of galvanized steel for improved rigidity. Base shall be structurally reinforced to accommodate the blower assembly and burner.

G. Blowers

1. Blower(s) shall be forward-curved, centrifugal, Class I or II, double width, double inlet, constructed G-90 galvanized steel.
2. Unit shall have a heavy-duty, solid-steel shaft. Wheels shall be balanced in two planes and done in accordance with AMCA standard 204-96, Balance Quality and Vibration Levels for Fans. The wheel blades shall be aerodynamically designed to minimize turbulence, increase efficiency and reduce noise. The wheel blades shall be securely attached to the wheel inlet ring. The wheel shall be firmly attached to the fan shaft with setscrews and keys
3. The blower assembly shall be isolated from the fan structure with vibrations isolators and flexible duct connections on discharge.

H. Motors

1. Motors shall be heavy-duty ball bearing type and furnished at the specified voltage, phase and enclosure. Motor mounting plate shall be constructed of heavy gauge galvanized steel and shall be designed to provide easy adjustment of the belt tension. Must meet all requirements of Section 230513.

I. Shafts

1. Shall be precision ground and polished. Heavy duty, pre-lubricated bearings shall be selected for a minimum (L50) life in excess of 200,000 hours of operation at maximum cataloged operating speed. They shall be designed for, and individually tested, specifically for use in air handling applications

J. Belts and Drives

1. Shall be oil and heat resistant, non-static, grip-notch type. Drives shall be cast type, precision machined and keyed, and secured attached to the fan and motor shafts.
2. Fan operating speed shall be factory set using adjustable pitch motor pulleys. All drives shall be a minimum of two (2) grooves above 2 HP

K. Gas Train

1. All gas equipment should conform to local code requirements. All gas manifold components shall be piped and wired at the factory.
2. Components to include:
 - a. Pilot-gas shut-off valve
 - b. Pilot-gas regulator
 - c. Pilot-gas valve
 - d. Main-gas shut-off valve
 - e. Main-gas regulator
 - f. Two (2) solenoid valves
 - g. Modulating-gas valve
 - h. Burner
 - i. Safety Controls
 - j. Motor starter with adjustable overloads
 - k. Air-flow safety switch
 - l. Electronic flame-safety relay
 - m. High-temperature limit switch
 - n. Main-gas regulator
 - o. Two (2) safety shutoff valves
 - p. Modulating-gas valve
 - q. Adjustable burner ON/Off inlet air duct-stat to shut off burner when inlet air is sufficiently warm to maintain space temperature.
 - r. Non-fused disconnect
 - s. Accessories

L. Packaged DX Cooling

1. Unit to be provided with a fully operational, integrated DX cooling system that is factory installed and tested. Shall include but not be limited to the following components:
 - a. Compressor(s)
 - b. Evaporator and Condenser Coil(s)
 - c. Condenser Fans
 - d. Controls
2. Refrigeration Components
 - a. Coil shall be constructed of copper tubing, permanently bonded to aluminum fins and enclosed in a galvanized steel frame.
 - b. Units with multiple coils shall be interlaced.
 - c. Unit to be R-454B or R-32 fully charged from the factory
 - d. Unit mounted condensing units with factory piping, power and controls.
 - e. Factory installed refrigerant leak detection system.
 - f. All piping to be insulated
3. Drain Pan
 - a. Provide with an integral, stainless steel, double pitched, drain pan that terminates on the unit exterior.

M. Outlet Dampers

1. Manufacturer shall provide and install on unit, when possible, a two-position, motor-operated damper with internal end switch to energize the blower-starter circuit, when damper is 80% open.

2. Blades shall be a maximum of 6" wide 16-gauge G-90 galvanized steel and shall be made to guarantee the absence of noticeable vibration at design air velocities.
3. Damper blades are to be mounted on friction-free synthetic bearings. Damper edges shall have PVC coated polyester fabric mechanically locked into blade edge. Jamb seals used are flexible metal, compression type.

N. Filters

1. The filters shall be (2") thick, aluminum mesh coated with super-filter adhesive, aluminum mesh with polyester foam or pleated throw away.
2. Aluminum-mesh filters shall have aluminum frames with media to be layers of split and expanded aluminum, varying in pattern to obtain maximum depth loading. Washable 2" filters shall be enclosed in two-piece, die-cut frame with diagonal supports.
3. Frame shall be constructed of heavy-duty beverage board. Filter media is supported on the air leaving side by a metal grid.

O. Filter Section

1. Shall be either insulated or non-insulated constructed of G-90 galvanized steel with filters supported by internal slides and with removable access panels.
2. Fresh-air inlet hood: Shall be constructed of G-90 galvanized steel with bird screen. Hood to prevent the intake of moisture and snow at normal operating conditions. Maximum filter face velocity of 400 ppm.

P. Electrical and Wiring

1. A single point electrical connection shall be supplied. The control circuit voltage shall be 115 volts. A control transformer shall be provided, when required.
2. Wiring in control enclosures shall be in accordance with the National Electrical Code and the local code, as it may affect the installation. Motor starter and variable frequency drive shall be provided.
3. Unit(s) shall be complete with all items such as relays, starters, switches, safety controls, conduit and wire as previously mentioned, and as required for proper operation.
4. All factory-mounted controls shall be factory pre-wired to the unit control panel. A safety disconnect switch shall be standard on all units and shall be sized according to the unit.
5. Provide with a powered GFCI duplex receptacle with weathertight hinged cover. Outlet shall not require a separate power connection.

Q. Unit Controls – Kitchen Hood Makeup

1. For kitchen hood exhaust-air replacement with supply air temperature control. A fixed discharge setpoint for heating and cooling will control the gas heating coil and DX cooling system capacities.
2. High- and low-discharge air sensor probes limit maximum and minimum discharge-air temperatures.

3. Makeup air unit airflow will vary based on the exhaust fan airflow based. A signal received from the kitchen hood control panel will adjust the supply airflow from the makeup air unit.
4. Unit manufacturer to include a remote-control panel to enable / disable unit and change operating mode.

R. Unit Controls – Space Temperature Control

1. For building exhaust-air replacement with modulated space- temperature control. A modulating space thermostat adjusts burner flame to maintain discharge-air temperature to compensate for changing building heat losses or gains. High- and low-discharge air sensor probes limit maximum and minimum discharge-air temperatures. Include a SUMMER- OFF/WINTER selector switch and exhaust-system interlocks control heater-blower operation. Supplied with remote-control panel with SUMMER-OFF/WINTER selector switch and a modulating-room thermostat.

S. Unit Controls – Space Pressure Control

1. A factory-supplied field wired VFD is provided which varies the speed of the blower wheel. A field wired Static Pressure Controller, which measures building pressure and closes and opens contacts on the VFD to accelerate or decelerate the blower speed to maintain the building pressure set on the Static Pressure Controller, controls the VFD. Fan speed will modulate down to 20%. Factory supplied automatic profiles maintain the burner profile pressure drop as the blower speed is varied.
2. See Section 232923 for complete VFD requirements. All VFD's on the project shall be the same, no exceptions. Coordinate with VFD supplier.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the Work of this Section in accordance with the manufacturer's printed instructions.
- B. During construction provide temporary closures of metal or taped polyethylene over openings into housing ducts to prevent dust from entering ductwork.
- C. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION

SECTION 23 8200 – TERMINAL HEATING EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all work required to provide and install the following Terminal Heating Devices indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Equipment Included in This Section
 - 1. Electric Terminal Heat
 - a. Unit Heaters
 - b. Cabinet Unit Heaters

1.2 SUBMITTALS

- A. Product Data: Catalog cuts, specifications, installation and maintenance instructions for each type of heater specified.
- B. Schedule: List manufacturer, unit type, model number, and performance data for each unit heater.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements: Heaters shall be UL listed.
- B. Certification: Affidavit from finned tube radiation manufacturer certifying that element has been tested in accordance with the requirements of IBR Testing and Rating Standard for finned tube radiation.

1.4 MAINTENANCE

- A. Special Tools: One (1) tool for each type and size vandal resistant fastener.

PART 2 - PRODUCTS

2.1 CONFIGURATION AND PERFORMANCE

- A. Refer to the equipment schedules for additional configuration and performance requirements.

2.2 ELECTRIC TERMINAL HEAT

- A. Electric Unit Heaters
 - 1. Acceptable Manufacturers
 - a. Berko
 - b. Brasch

- c. Indeeco
 - d. King Electric
 - e. Markel
 - f. Modine
 - g. Q-Mark
 - h. Raywall
 - i. Redd-I
 - j. Stelpro
 - k. Trane
 - l. TPI Corp
2. Unit Casing: Constructed of steel sheet formed, reinforced, and braced for rigidity, with steel louvers or deflectors with sufficient rigidity to prevent vibration at all fan speeds.
 - a. Materials:
 - 1) Galvanized Steel Sheet: ASTM A 653, coating designation G90.
 - 2) Cold-Rolled Steel Sheet: ASTM A 366, cleaned, degreased and phosphatized.
 - b. Factory Finish: Minimum two (2) coat baked enamel finish on exposed surfaces, color as directed.
 3. Provide with discharge nozzle for units to throw air from the specified mounting height to the floor or as specified on the drawings. At a minimum, units shall include the following:
 - a. Horizontal Delivery Units: Adjustable horizontal and vertical louvers.
 - b. Vertical Delivery Units: Louvered deflector mounted outside fan orifice.
 4. Provide all necessary mounting hardware to support the heater.
 5. Electric-Resistance Heating Elements: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550° F at any point during normal operation.
 6. Circuit Protection: One (1)-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.
 7. Wiring Terminations: Stainless-steel or corrosion-resistant material.
 8. Fan Assembly (Refer to schedule for fan type)
 - a. Fan (Propeller): Multiple blade propeller type, statically and dynamically balanced, and directly connected to electric motor.
 - b. Fan (Blower): Double width, double inlet (DWDI), forward curved, belt driven, assembly with spider ball bearings.
 9. Motor: Single phase, totally enclosed electric motor of the permanent split capacitor or shaded pole type, with resilient mounting, terminal box for wiring connections, built-in overload protection, and ball or sleeve bearings with oilers, or permanently lubricated bearings.
 10. Refer to schedule for control type and electrical requirements for the unit.

B. Electric Cabinet Unit Heaters

1. Acceptable Manufacturers

- a. Berko
 - b. Brasch
 - c. Indeeco
 - d. King Electric
 - e. Markel
 - f. Q-Mark
 - g. Raywall
 - h. Redd-I
 - i. Stelpro
 - j. Trane
 - k. TPI Corp
2. Unit Casing: Constructed of steel sheet formed, reinforced and braced for rigidity, with stamped grilles.
 - a. Materials:
 - 1) Galvanized Steel Sheet: ASTM A 653, coating designation G90.
 - 2) Cold-Rolled Steel Sheet: ASTM A 366, cleaned, degreased and phosphatized.
 - b. Factory Finish: Minimum two (2) coat baked enamel finish on exposed surfaces, color as directed.
 - c. Insulation: Insulate interior surfaces of casing panels with 1/2 inch glass fiber meeting NFPA 90A requirements.
 - d. Vertical Units: Minimum 18 gauge construction with removable front panel.
 - e. Horizontal Units: Minimum 18 gauge construction with hinged bottom panel.
 3. Electric-Resistance Heating Elements: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550° F at any point during normal operation.
 - a. Circuit Protection: One (1)-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.
 - b. Wiring Terminations: Stainless-steel or corrosion-resistant material.
 4. Fan Assembly: Blow thru design.
 - a. Fans: Forward curved centrifugal type, double width, statically and dynamically balanced, and directly connected to electric motor.
 5. Motors: Three (3) speed, single phase electric motors of the permanent split capacitor or shaded pole type, with resilient mounting, built-in overload protection with automatic reset, and ball or sleeve bearings with accessible oilers, or permanently lubricated bearings.
 6. Filter Section: Built-in filter frame mounted at air inlet with disposable air filters.
 - a. Vertical Units: Filters removable without removing front panel for cabinet type units.
 - b. Horizontal Units: Filters removed by pivoting hinged bottom panel.
 7. Refer to schedule for cabinet style, control type and electrical requirements for the unit.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the Work of this section in accordance with the manufacturer's printed installation instructions, unless otherwise specified.

END OF SECTION

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SECTION 23 0500 – HVAC COMMON WORK RESULTS

PART 1 - GENERAL

1.1 SCOPE

- A. The work under this section includes basic mechanical requirements, which are applicable to all Division 21, 22 and 23 sections.
- B. Overview of work
 - 1. HVAC
 - 2. Plumbing
- C. In these documents, "Contractor" refers to the mechanical contractor and all their subcontractors, unless listed otherwise. The division of work within the mechanical scope is the responsibility of the lead mechanical contractor.
- D. Contractor is responsible for providing fully functional systems.
- E. If work is shown on the drawings or listed in the specifications, it shall be included by the Contractor.
- F. If equipment is provided by the Contractor, it shall be installed by the Contractor, unless noted otherwise.
- G. The drawings are necessarily diagrammatic by their nature and are not intended to show every connection in detail or every item in its exact location. Carefully investigate structural and finish conditions and coordinate the separate trades in order to avoid interference between the various phases of Work. Organize and lay out Work so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Install all Work parallel or perpendicular to building lines unless otherwise noted.
- H. The intent of the Drawings is to establish the types of systems and functions; not to set forth each item essential to the functioning of the system. Install the Work complete, including minor details necessary to perform the function indicated. Review pertinent Drawings and adjust the Work to conditions shown. Where discrepancies occur between Drawings, Specifications, and actual field conditions, immediately notify the Architect and Engineer for interpretations.
- I. All sizes as given are minimum except as noted.
- J. Materials shall be new (unless noted or stated otherwise), first class, and workmanlike, and shall be subject at all times to the Architect's, Engineer's, and Owner's observations from the commencement until the acceptance of the completed work.
- K. Kitchen Equipment
 - 1. Kitchen Equipment will be provided by the Kitchen Equipment Contractor (KEC) as outlined in the Kitchen Consultant's documents. Refer to the Kitchen Consultants documents for the description of work to be completed by the KEC as well as the various other contractors. This includes the mechanical, plumbing, and electrical contractors.

1.2 REFERENCES

- A. Applicable provisions of Division 0 and Division 1 govern work under this Section.
- B. All work shall conform to the most current version of all applicable codes and standards or the version adopted by the jurisdiction.
- C. Codes
 - 1. International Building Code
 - 2. International Mechanical Code
 - 3. Uniform Plumbing Code
 - 4. International Fuel Gas Code
 - 5. International Fire Protection Code
 - 6. International Energy Conservation Code
 - 7. NFPA – National Fire Protection Association
 - 8. State or City Codes for the City of Colfax, Iowa.
- D. Standards
 - 1. ASHRAE Standard 15
 - 2. ASHRAE Standard 62
 - 3. ASHRAE Standard 90.1
 - 4. SMACNA – Sheet Metal and Air Conditioning Contractors National Association, Inc.
 - 5. AMCA – Air Movement and Control Association
 - 6. ASME – American Society of Mechanical Engineers
 - 7. ANSI – American National Standards Institute
 - 8. ARI – Air Conditioning and Refrigeration Institute
- E. Governing Bodies
 - 1. Owner's Insurance Company
 - 2. State Fire Marshal
 - 3. AHJ – Authority Having Jurisdiction
 - 4. UL - Underwriters Laboratories

1.3 SUBMITTALS

- A. The review of shop drawings by the Engineer is for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Corrections or comments made on the shop drawings during this review do not relieve the contractor from compliance with the requirements of the plans and specifications. Approval of a specific item shall not include approval of an assembly of which the item is a component. The Contractor is responsible for: dimensions to be confirmed and correlated at the jobsite; information that pertains solely to the fabrication processes or to the means, methods, techniques, sequences and procedures of construction; coordination with the Work of all trades; and for performing all work in a safe and satisfactory manner.
- B. Refer to individual technical specification sections for specific submittal requirements.
- C. Submission of shop drawings electronically In .PDF format is preferred.
- D. If hard copies of shop drawings are utilized on this project, coordinate the quantity with the Architect and General Contractor. Provide one (1) copy for the Engineer's records.
- E. The Engineer will review one resubmittal for each product. If additional resubmittals are required, the Contractor shall be responsible to bear the cost for the Engineer to recheck and handle the additional shop drawing submittals. Documents will not be reviewed until payment is agreed upon.
- F. Contractor may request electronic AutoCAD files from the Engineer if needed to complete their shop drawings. An Electronic File Request Form will be sent to the contractor if files are requested and must be completed and signed before the AutoCAD files are released to the Contractor.
- G. All submittals for equipment and materials shall be reviewed and approved by the engineer prior to the fabrication or release by the contractor. This includes fabrication drawings for ductwork and fire protection and the coordination of equipment between trades. The release, purchase, installation or fabrication of any items prior to the contractor receiving an approved shop drawing will be at the contractor's own risk. Any rework that results will be provided by the contractor at no cost to the Owner or design team.
- H. Submittals must be reviewed and approved by the Contractor before submitting to the Engineer.
- I. Submittals shall be grouped to include complete submittals of related systems, products, and accessories in a single submittal. Mark dimensions and values in units to match those specified.

1.4 QUALITY ASSURANCE

- A. Warranty
 - 1. Equipment warranty shall be a minimum of one (1) year from date of factory supervised startup or from the date of substantial completion, whichever is later.
 - 2. Contractor shall warranty all of their work for one (1) year from the date of substantial completion.
- B. Equipment Capacity
 - 1. All equipment submitted shall meet or exceed the capacity listed in the specifications and

schedules. This includes airflows / static pressure, heating / cooling capacities, pump flow / head, and all values listed in the construction documents.

2. All submitted motor brake horsepower's submitted shall be at least 5% less than the rated nominal motor horsepower. No motors shall be selected in the motor service factor with the exception of fire pumps.
 3. The mechanical contractor shall be responsible for any structural, electrical, piping, ductwork or other utility modifications resulting from an alternate manufacturer than the basis of design being used.
- C. These documents are diagrammatical in nature and intended to convey scope and general arrangement of the mechanical systems. Not all fittings, risers, size changes, offsets, valves, accessories, etc. are shown on plan. If items are required to make a system fully operational but not shown on plan or in these specifications, they shall be included by the contractor.
- D. The intent of the Drawings is to establish the types of systems and functions; not to set forth each item essential to the functioning of the system. Install the Work complete, including minor details necessary to perform the function indicated. Review pertinent Drawings and adjust the Work to conditions shown. Where discrepancies occur between Drawings, Specifications, and actual field conditions, immediately notify the Architect and Engineer for interpretations.
- E. It is the contractor's responsibility to determine all utility routing prior to purchase and installation of material.
- F. The contractor shall report any discrepancies between these documents and site conditions immediately to the Engineer prior to submitting a bid or starting work. Submittal of a bid indicates that the contractor and the contractor's subcontractors have carefully and thoroughly reviewed the drawings, specifications, and other construction documents and have found them complete and free from ambiguities and sufficient for the purposes intended.
- G. Install all equipment per the manufacturer's requirements / recommendations.
- H. No equipment provided or installed shall contain mercury.
- I. Manufacturer Supplier Inspection & Startup
1. The following equipment shall have a factory representative perform start-up. The procedure shall be documented and submitted to the design team and Owner. Include copies of startup reports in the Operations & Maintenance Manuals.
 - 1) Make Up Air Unit
 - 2) Rooftop Units
- J. All equipment shall be UL listed where applicable.

1.5 ELECTRONIC DOCUMENT RELEASE

- A. Electronic versions of the bid documents will be made available to the contractors for use during the bidding process and to help generate fabrication drawings for various systems. A summary of the requirements for the various document types is listed below:
1. PDF
 - a. Contact the Construction Manager or Architect to obtain a PDF version of the Bid Documents. No Document Release Form is required.

2. AutoCAD

- a. KEDbluestone Engineering can provide an AutoCAD version of the bid documents for the contractor to use for generating shop drawings and fabrication drawings. This will include plan drawings with the architectural background. The contractor is responsible for incorporating any modifications that occur during bidding by all disciplines. Details and schedules will not be included.
- b. A document release form (see attached) will be required to be completed by the contractor to determine the version of AutoCAD and drawings required. No fee is associated with these drawings.

3. REVIT

- a. The REVIT drawings will be converted to AutoCAD and then transferred to the contractor.
- b. KEDbluestone Engineering can provide an AutoCAD version of the bid documents for the contractor to use for generating shop drawings and fabrication drawings. This will include plan drawings with the architectural background. The contractor is responsible for incorporating any modifications that occur during bidding by all disciplines. Details and schedules will not be included.
- c. A document release form (see attached) will be required to be completed by the contractor to determine the version of AutoCAD and drawings required.
- d. Submittal of the document release form will be required prior to the AutoCAD files being transmitted.

1.6 SUBSTITUTIONS

- A. All manufacturers listed as Acceptable Manufacturers in each specification section are considered equal to the basis of design. The basis of design is preferred and will take precedence. Any products from an alternate approved manufacturer need to meet the requirements and performance specified and shall be equal to the basis of design.
- B. The Contractor may request permission for a substitution of any item (equipment or material), subject to the following conditions:
 1. Submit substitution requests in writing to the Engineer, on a form supplied by the Engineer. A sample copy of this form is included at the end of this section. An electronic copy can also be provided to the Contractor by the Engineer.
 2. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contractor documents, the Contractor is responsible for all costs involved in integrating the equipment or accessories into the system and the assigned space and for obtaining the performance from the system into which these items are placed as well as any re-design costs incurred by the Architect or Engineer. The Contractor is also responsible for coordinating changes required by other trades.
 3. Any requests for alternate manufacturers must be submitted to the Architect/Engineer at least ten (10) days prior to bid day. Incomplete substitution requests will not be considered.
- C. Approval
 1. No work involving requests for substitution shall commence without written approval on the provided form by the Engineer.

2. Any work started or material ordered/installed by the Contractor without written approval shall be removed/repared at the sole expense of the contractor. The Contractor will also be responsible for any costs incurred by the Owner for such rework.

1.7 COORDINATION DRAWINGS

- A. The mechanical contractor shall be responsible for producing coordination drawings. The drawings will need to incorporate piping, ductwork, equipment, lighting, conduits, building structure and all other building and system components that will need to be coordinated for proper systems installation and operation.
- B. The drawings will be 1/4" scale.
- C. Coordination meetings will be conducted on site with all concerned contractors present. Representatives from the Owner, Architect and Engineer will also be present to review conflicts and approve contractor variations to the contract documents.

1.8 CONTINUITY OF EXISTING SERVICES AND SYSTEMS

- A. No outages shall be permitted on existing systems except at the time and during the interval specified by the Engineer and the Owner. Any outage must be scheduled when the interruption causes the least interference with normal work schedules and business routines. No extra costs will be paid to the Contractor for such outages which must occur outside of regular weekly working hours unless specifically noted in the Specifications or in the bidding requirements.
- B. This Contractor shall restore any mechanical services interrupted as a result of a lack of coordination to proper operation as soon as possible.
- C. Contractor shall notify Owner of any utility service shutdown forty-eight (48) hours in advance. This includes gas, water, sanitary, storm, fire protection, cooling, and heating systems.

1.9 REGULATORY AND UTILITY REQUIREMENTS

- A. Contractor is responsible for coordinating all required site inspections by authorities having jurisdiction. Contractor shall notify General Contractor of all scheduled inspections seven (7) working days prior to site visit.
- B. Contractor is responsible for paying for all fees, permits, and inspections that are required to complete their work.
- C. Contractor shall include all work required to relocate utilities and meters as shown on drawings.
- D. Contractor shall include all work required to install new utilities and meters as shown on drawings. This includes any new service and meter fees in coordination with the utility company.
- E. Utility work 5'-0" from outside of building is by others.

1.10 PROTECTION OF FINISHED SURFACES

- A. Furnish one (1) can of touch-up paint for each different color factory finish for equipment furnished by the Contractor. Deliver touch-up paint with other "loose and detachable parts" as covered in the General Requirements.

1.11 SEALING AND FIRESTOPPING

- A. Sealing and firestopping of sleeves/openings between ducts and piping and the structural or partition opening shall be the responsibility of the General Contractor. The contractor responsible shall hire individuals skilled in such work to do the sealing and firestopping. These individuals hired shall normally and routinely be employed in the sealing and fireproofing occupation.

1.12 WORK BY OWNER AND/OR OWNER AGENCY

- A. Asbestos abatement, removal and disposal, if required, will be by the Owner under separate contract.

1.13 OMISSIONS

- A. No later than ten (10) days before bid opening, the Contractor shall call the attention of the Architect and Engineer to any materials or apparatus the Contractor believes to be inadequate and to any necessary items of work omitted.

1.14 DELIVERY, STORAGE, AND HANDLING

- A. All equipment and materials shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.
- B. Store equipment indoors in clean dry space with uniform temperature to prevent condensation or damage from the elements.
- C. Take such precautions as are necessary to protect apparatus and materials from damage. Damaged equipment shall be, as determined by the Owner and/or Engineer, placed in first class operating condition or be returned to the source of supply for repair or replacement.
- D. Protect factory finish from damage during construction operations until acceptance of the Project. Restore any finishes that become stained or damaged to Owner's satisfaction.

1.15 DIVISION OF WORK AND COORDINATION

- A. The Electrical Contractor is responsible for providing and installing power wiring up to equipment provided by others for a single point connection. Internal wiring of equipment provided by others shall be the responsibility of the contractor responsible for providing and installing the equipment.
- B. Controls, disconnect switches, starters, variable frequency drives, etc. shall be provided and installed by the contractor noted on the plans and in the specifications. It is the responsibility of the Contractor to request written clarification for any ambiguity regarding division of work and coordination at least ten (10) days prior to bid.
- C. See Section 230900 for scope of wiring required for Temperature Control systems.
- D. Utilities routed within the building shall be installed in an orderly manner. All work will be coordinated with other disciplines prior to installation. The following list ranks the priority of the utilities to be installed:
 - 1. Light fixtures

2. Gravity piping
 3. Electrical busduct
 4. Ductwork
 5. Cable tray
 6. All other piping
 7. Electrical conduits
- E. Any installed work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.
- F. Coordinate work with the Testing and Balancing (TAB) Contractor. Verify system completion to the TAB Contractor such as pressure testing, chemical treatment, filling of liquid systems, proper pressurization and air venting of hydronic systems, clean filters, clean strainers, controls adjusted and calibrated, fire/smoke damper integration ready for testing, adjusting and balancing work. Install dampers, shutoff and balancing valves, flow measuring devices, gauges, temperature controls, etc., required for functional and balanced systems. Assist the TAB Contractor as needed to complete their work.
- G. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- H. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- I. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.16 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.
- B. In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation as applicable:
1. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
 2. A control sequence describing start-up, operation, and shutdown.
 3. Description of the function of each principal item of equipment.
 4. Installation instructions.
 5. Safety precautions for operation and maintenance.
 6. Diagrams and illustrations.

7. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers and replacement frequencies.
8. Performance data.
9. Where applicable, pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
10. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.

1.17 RECORD DRAWINGS

- A. The Contractor shall maintain at least one copy each of the Specifications and Drawings on the job site at all times.
- B. The Architect will provide the Contractor with a suitable set of Contract Drawings on which daily records of changes and deviations from contract shall be recorded. Dimensions and elevations on the record drawings shall locate all buried or concealed piping, conduit, or similar items.
- C. The daily record of changes shall be the responsibility of Contractor's field superintendent. No arbitrary mark-ups will be permitted.
- D. At completion of the project, the Contractor shall submit the marked-up record drawings to the General Contractor prior to final payment.

1.18 SPECIAL REQUIREMENTS

- A. Contractor bid shall allow color selection by Architect of any piece of exposed equipment from all available colors. Base bid color selection shall include those considered 'premium' by the manufacturer.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Conditions: Provide new products of manufacturers regularly engaged in production of such equipment. Provide the manufacturer's latest standard design for the type of product specified.

2.2 ACCESS PANELS AND DOORS

- A. Provide access panels and/or doors where required to maintain access to the electrical installation and where noted on the Drawings.
- B. Lay-in Ceilings
 1. Removable lay-in ceiling tiles in 2 x 2 foot or 2 x 4 foot configuration provided under other divisions are sufficient; no additional access provisions are required unless specifically indicated.

C. Plaster/Gypsum Walls and Ceilings

1. 16 gauge frame with not less than a 20 gauge hinged door panel, prime coated steel for general applications, stainless steel for use in toilets, showers and similar wet areas, concealed hinges, screwdriver operated cam latch for general application, key lock for use in public areas, UL listed for use in fire rated partitions if required by the application. Use the largest size access opening possible, consistent with the space and the equipment needing service; minimum size is 12" by 12".

2.3 SEALING AND FIRESTOPPING

A. Fire and/or Smoke Rated Penetrations

1. Manufacturers
 - a. 3M, STI/SpecSeal, Tremco, Hilti or approved equal.
2. All firestopping systems shall be by the same manufacturer.
3. Submittals
 - a. Contractor shall submit product data for each firestop system. Submittals shall include product characteristics, performance and limitation criteria, test data, MSDS sheets, installation details and procedures for each method of installation applicable to this project. For non-standard conditions where no UL tested system exists, submit manufacturer's drawings for UL system with known performance for which an engineering judgment can be based upon.
4. Product
 - a. Firestop systems shall be UL listed or tested by an independent testing laboratory approved by the Department of Commerce.
 - b. Use a product that has a rating not less than the rating of the wall or floor being penetrated. Reference architectural drawings for identification of fire and/or smoke rated walls and floors.
 - c. Contractor shall use firestop putty, caulk sealant, intumescent wrap strips, intumescent fire stop collars, fire stop mortar or a combination of these products to provide a UL listed system for each application required for this project. Provide mineral wool backing where specified in manufacturer's application detail.

B. Non-Rated Penetrations

1. Piping Penetrations Through Below Grade Walls
 - a. In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the piping and the cored opening or a water-stop type wall sleeve.
2. Piping and Ductwork Penetrations
 - a. At penetrations of non-rated interior partitions, floors and exterior walls above grade, use urethane caulk in annular space between pipe/duct and sleeve or opening.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations
- D. Install equipment to allow right of way for piping installed at required slope.
- E. Provide clearance for inspection, repair, replacement, and service to all equipment to include a minimum of 36 inches from all obstructions (walls, structure, ductwork, pipes, etc.). Clearance shall maintain access to all electrical panels, access doors, controllers, valves, junction boxes and operators and include the area directly in front of and above the system components.

3.2 EXCAVATION AND BACKFILL

- A. Perform all excavation and backfill work to accomplish indicated mechanical systems installation in accordance with Section 312316.13 - Trenching.

3.3 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases not less than 4 inches larger in both directions than supported unit.
 - 2. All pads to be a minimum of 4" thick unless noted otherwise. Thicken pads as needed to accommodate the slope of slab / grade around the equipment. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Indoor or outdoor equipment meeting any or all of the following requirements shall be installed on housekeeping pads:
 - a. Floor mounted motorized equipment.
 - b. All floor or ground mounted air handling equipment and fans.
 - c. All heating, cooling, plumbing, and fire protection equipment and associated floor mounted accessories located in mechanical spaces.
 - d. Equipment installed in areas with uneven surfaces and surfaces that are not level.
 - e. As required by the equipment manufacturer
 - 8. Refer to plans and details for additional pad locations.

3.4 PAINTING

- A. Exposed piping in occupied areas to be painted by others. Coordinate color with architect.
 - 1. Contractor to prep duct and piping as needed to accept paint.
- B. Contractor shall paint the following items with two (2) coats of exterior enamel over one (1) coat primer. Select paint to be compliant with material being used, i.e. metal, plastic, etc:
 - 1. All exposed natural gas piping. Color to be coordinated with the Architect.

3.5 SEALING AND FIRESTOPPING

- A. Fire and/or Smoke Penetrations
 - 1. Install approved product in accordance with the manufacturer's instructions where a pipe/duct penetrates a fire rated surface.
 - 2. Where firestop mortar is used to infill large fire-rated floor openings that could be required to support weight, provide permanent structural forming. Firestop mortar alone is not adequate to support any substantial weight.
- B. Non-Rated Surfaces
 - 1. When the opening is through a non-fire rated wall, floor, ceiling or roof the opening must be sealed using an approved type of material.
 - 2. Install escutcheons or floor/ceiling plates where pipe/duct penetrates non-fire rated surfaces in occupied spaces. Occupied spaces for this paragraph include only those rooms with finished ceilings and the penetration occurs below the ceiling.
 - 3. In exterior wall openings below grade, assemble rubber links of mechanical seal to the proper size for the pipe/duct and tighten in place, in accordance with the manufacturer's instructions. Install so that the bolts used to tighten the seal are accessible from the interior of the building or vault.
 - 4. At interior partitions, pipe/duct penetrations are required to be sealed for all clean rooms, laboratories, and most hospital spaces, computer rooms, dormitory rooms, telephone/data/com rooms and similar spaces where the room pressure or odor transmission must be controlled. Apply sealant to both sides of the penetration in such a manner that the annular space between the sleeve and the pipe/duct is completely filled.

3.6 HOUSEKEEPING AND CLEAN UP

- A. The Contractor shall clean up and remove from the premises, on a daily basis, all debris and rubbish resulting from its work and shall repair all damage to new and existing equipment resulting from its work. When job is complete, this Contractor shall remove all tools, excess material and equipment, etc., from the site.

3.7 SITE OBSERVATIONS

- A. Site observations shall be performed by the Engineer at the following project milestones:
 - 1. Prior to enclosure of the following areas:

- a. Underfloor
- b. Walls and chases
- c. Raised floor
- d. Above the ceiling

2. Final project completion

- B. Contractor shall provide seven (7) working days' notice to Engineer prior to site visit.
- C. The Engineer is only responsible to conduct one (1) final site visit. If upon visiting the site, the Engineer finds that not enough work is complete for the final site visit, the Contractor shall be responsible to bear the cost for the Engineer to travel to the site and revisit. Revisiting will not occur until payment is agreed upon.

3.8 EQUIPMENT STARTUP

- A. Contractor shall provide startup of equipment by factory certified personnel for equipment listed above.
- B. For all other equipment, Contractor shall perform startup per manufacturer's requirements. Startup shall be performed by personnel qualified for this work.
- C. Contractor shall test equipment to be fully functional. Test all equipment safeties and emergency stops. Test all control set-points and equipment modes.
- D. Contractor shall return to site as needed to adjust equipment for seasonal equipment performance changes.

3.9 OWNER TRAINING

- A. Contractor shall include at least eight (8) hours for each maintenance staff shift group in their bid to provide complete Owner training for all the mechanical systems. Training shall include explanation of system operation, startup/shutdown, routine maintenance, seasonal changes, and controls adjustments. Coordinate acceptable training schedule with Owner.
- B. All training provided for the Owner shall comply with the format, general content requirements and submission guidelines specified under Section 019101, or 019102.
- C. Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for the duration noted in the technical Specifications.

3.10 PROJECT CLOSEOUT REQUIREMENTS

- A. Final project closeout tasks
 - 1. Deliver all spare parts listed in each specification section. Deliver to Owner chosen location.
 - 2. All equipment labeled per specifications.
 - 3. All equipment cleaned and ready for use. Install new filters in all equipment with filters; do not use Owner's spare filter sets.

B. Contractor requirements

1. Marked up drawings and specifications provided to Engineer for incorporation of as-built drawings or to serve as the as-built drawings depending on the project requirements. As-built drawings shall be clean and legible.
2. Operation and Maintenance (O & M) Manuals shall include the following:
 - a. Contractor contact for warranty work
 - b. Approved shop drawings, incorporating all review comments
 - c. Warranty copies
 - d. Equipment start-up reports
 - e. Testing and balancing reports
 - f. Operation and maintenance instructions
3. Utility Rebate Forms
 - a. Contractor shall submit completed energy rebate forms for each piece of equipment that is eligible for a rebate. Eligible equipment shall include, but not be limited to the following:
 - 1) Rooftop Air Conditioning Units
 - 2) Makeup Air Units
 - 3) Building Automation System
 - b. Contractor to complete information regarding equipment. Submit form to Owner, Owner will complete Owner's contact information and send the completed form to the utility.
4. Three (3) final approved O & M Manuals shall be delivered to Owner. Each manual shall be an appropriately sized three (3) ring binder with a vinyl cover and printed spine and cover labels. Each section shall have a printed divider tab. Each section shall be listed in a table of contents at the beginning of the manual.

END OF SECTION

(ELECTRONIC DOCUMENT RELEASE FORM & SUBSTITUTION REQUEST FORMS ATTACHED)

Document Release Form

Information Requested:

Project Name:
Drawings Requested:

Media Type: (Check all that are applicable)

- | | |
|--|--|
| <input type="checkbox"/> AutoCAD DWG Files (Version _____) | <input type="checkbox"/> Adobe PDF Files |
| <input type="checkbox"/> REVIT Files (Version _____) | <input type="checkbox"/> Other |

Requesting Party:

Name:	Address 1:
Company:	Address 2:
Signature:	Email Address:
Date:	Phone #:

KEDbluestone Use:

Form Sent By: _____ Date: _____

KEDbluestone Project #: _____

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SUBSTITUTION REQUEST FORM (DURING BIDDING)

We submit for your consideration the following product instead of the specified item for the following project:

PROJECT: _____

SPEC. SECTION	SPEC. TITLE	PARAGRAPHS	SPECIFIED ITEM
_____	_____	_____	_____

Proposed Substitution: _____

MANUFACTURER	TRADE NAME	MODEL NO.
_____	_____	_____

Attached data includes product description, specifications, drawings, photographs, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including Architectural and Engineering design, detailing, and construction costs caused by the substitution.

Submitted by:

Signature

Firm

Email Telephone
Date

Engineer's Review and Action

- ☐ Substitution Approved
- ☐ Substitution Approved As Noted
- ☐ Substitution Rejected
- ☐ Substitution Request Received Too Late

Signed by:

Date

Supporting Data Attached:

☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ Other _____

SECTION 23 0529 – PIPE HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the following Pipe Hangers and Supports indicated by the Contract Documents with supplementary items necessary for proper installation.

1.2 REFERENCES

- A. Refer to Section 230719, PIPING INSULATION for work related to this section.

1.3 SUBMITTALS

- A. Product Data
 - 1. Manufacturer's catalog sheets and specifications for hangers and supports materials.
 - 2. Installation instructions.
 - 3. Schedule indicating what type of hangers or support will be used for various piping types.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Comply with the applicable requirements of the ASME B31 Piping Codes.
 - 2. Unless otherwise shown or specified, comply with the requirements of the Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS) Standards SP-58, and SP-69.
 - 3. Hang and support cast iron soil pipe and fittings in accordance with the recommendations of the Cast Iron Soil Pipe's Institute's (CISPI) Cast Iron Soil Pipe and Fittings Handbook.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Combination clevis hanger, pipe insulation shield and vapor barrier jacketed high density insulating saddle with companion high density filler piece.
 - 1. Insulating saddles and filler pieces shall be of the same thickness and materials as the adjoining pipe insulation. Saddles shall cover the lower 180 degrees of the pipe or tubing, and companion filler pieces shall cover the upper 180 degrees of the pipe or tubing. Physical sizes, gages, etc. of the components of insulated hangers shall be in accordance with the following schedule:

PIPE OR TUBING SIZE (Inches)	SHIELD LENGTH (Inches)	SHIELD GAUGE	SADDLE LENGTH (Inches)	VAPOR BARRIER JACKET LENGTH (Inches)
Up to 2-1/2	4	16	6	10
3 to 6	4	14	6	10
8 to 14	10	12	12	16
16 and up	10	10	12	16

- B. Pipe Insulation Shields: Fabricated of steel, with a minimum arc of 180 degrees, unless otherwise indicated. Shields for use with hangers and supports, with the exception of combination clevis type hangers, shall be in accordance with the following schedule:

PIPE OR TUBING SIZE (Inches)	SHIELD LENGTH (Inches)	SHIELD GAUGE
Up to 2-1/2	8	18
3 to 8	10	16
10 to 14	12	12
16 and up	18	10

- C. Pipe Hangers: Height adjustable standard duty clevis type, with cross bolt and nut.
1. Pipe spreaders or spacers shall be used on cross bolts of clevis hangers, when supporting piping ten (10) inches in size and larger.
 2. Swivel ring type hangers will be allowed for sprinkler piping up to a maximum of two (2) inches in size.
- D. Adjustable Floor Rests and Base Flanges: Steel.
- E. Hanger Rods: Mild, low carbon steel, fully threaded or threaded at each end, with two (2) nuts at each end for positioning rod and hanger, and locking each in place.
- F. Riser Clamps: Malleable iron or steel.
- G. Rollers: Cast Iron.
- H. Specialty: Fasteners, supports and hangers for PEX piping shall be specifically designed for PEX piping.

2.2 ANCHORS AND ATTACHMENTS

- A. Sleeve Anchors (Group II, Type 3, Class 3): Molly's Div./USM Corp. Parasleeve Series, Ramset's Dynabolt Series, or Red Head/Phillips AN, HN, or FS Series.
- B. Wedge Anchors (Zinc Plated, Group II, Type 4, Class 1): Hilti's Kwik Bolt Series, Molly's Div./USM Corp. Parabolt PB Series, Ramset's Trubolt T Series, or Red Head/Phillips WS Series.
- C. Self-Drilling Anchors (Group III, Type 1): Ramset's RD Series, or Red Head/Phillips S Series.
- D. Non-Drilling Anchors (Group VIII, Type 1): Ramset's Dynaset DS Series, Hilti's HDI Series, or Red Head/Phillips J Series.
- E. Stud Anchors (Group VIII, Type 2): Red Head/Phillips JS Series.

- F. Beam Clamps: Forged steel beam clamp, with weldless eye nut (right hand thread), steel tie rod, nuts, and washers, Grinnell's Fig No. 292 (size for load, beam flange width, and rod size required).
- G. Metal Deck Ceiling Bolts: B-Line Systems' Fig. B3019.

2.3 FASTENERS

- A. Bolts, Nuts, Washers, Lags, and Screws: Medium carbon steel; size and type to suit application; galvanized for high humidity locations, and treated wood; plain finish for other interior locations. Except where shown otherwise on the Drawings, furnish type, size, and grade required for proper installation of the Work.

2.4 SHOP PAINTING AND PLATING

- A. Hangers, supports, rods, inserts and accessories used for pipe supports, unless chromium plated, cadmium plated or galvanized shall be shop coated with metal primer paint. Electroplated copper hanger rods, hangers and accessories shall be used when hangers are in direct contact with copper pipe or copper tubing.
- B. Hanger supports for chromium plated pipe shall be chromium plated brass.

2.5 ROOFTOP SUPPORT SYSTEMS

- A. Rooftop supports for piping equipment shall be provided for installation without requiring roof penetrations, flashing, or damage to the roofing material. Height-adjustable supports may be used where necessary. Support piping a minimum of 4" above the roof surface.
- B. Materials:
 - 1. Support bases shall be made of an engineered material with appropriate additives for UV protection. All structural steel components shall be hot-dipped galvanized.
 - 2. The support shall have a continuous bottom surface to provide even load distribution and minimize point loading of the roof membrane. The support base will have a radiused edge to enhance compatibility with roof membranes.
 - 3. Coordinate static load rating of the support(s) with the specific application being served.
 - 4. Accessories: Clamps, bolts, nuts, washers, and other devices as required for a complete system.
- C. Applications:
 - 1. Fixed Strut Pipe Hanger Supports: Size and load ratings for the application
 - 2. Adjustable Strut Pipe Hanger Supports: Height adjustable, size and load ratings for the application
 - 3. Adjustable Single Piping Supports: Height adjustable, size and load ratings for the application
 - 4. Block Supports: Size and load ratings for the application

5. Roller Supports: Height adjustable, size and load ratings for the application
 6. Bridge Assemblies:
 - a. Suitable for multiple piping runs or equipment
 - b. Size and load ratings for the application
 7. Post Base Assemblies:
 - a. For use with vertical sections of channel support systems
 - b. Size, channel support configuration, and load ratings for the application
- D. Acceptable Manufacturers:
1. Caddy/Pentair
 2. Cooper B-Line
 3. Mifab, Arlington
 4. Rooftop Blox
 5. Haydon
 6. MAPA Products
 7. Miro Industries

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Do not hang or support one (1) pipe from another or from ductwork.
- B. Do not bend threaded rod.
- C. Do not hang or support equipment from the bottom chord of joists.
- D. Support all insulated horizontal piping conveying fluids below ambient temperature, by means of hangers or supports with insulation shields installed outside of the insulation.
- E. Space hangers or supports for horizontal piping on maximum center distances as listed in the documents, and as follows.
 1. Cast Iron Soil Pipe:
 - a. General:
 - 1) Where piping is suspended on centers in excess of 18 inches by means of non-rigid hangers, provide sway bracing to prevent horizontal pipe movement.
 - 2) Additionally, brace piping five (5) inches and larger to prevent horizontal movement and/or joint separation. Provide braces, blocks, rodding or other suitable method at each branch opening, or change of direction
 - b. For Bell & Spigot Cast Iron Soil Pipe: Space hangers or support pipe at each joint or on maximum centers of five (5) feet. Place hangers or supports as close as

possible to joints and when hangers or supports do not come within one (1) foot of a branch line fitting, install an additional hanger or support at the fitting.

- c. For Hubless Cast Iron Soil Pipe: Space hangers or support pipe at each joint or on maximum centers of five (5) feet. Place hanger or supports as close as possible to joints and when hangers or supports do not come within one (1) foot of a branch line fitting, install an additional hanger or support at the fitting.
2. For Directional Changes: Install a hanger or support close to the point of change of direction of all pipe runs in either a horizontal or vertical plane.
3. For Concentrated Loads: Install additional hangers or supports, spaced as required and directed, at locations where concentrated loads such as in-line pumps, valves, fittings or accessories occur, to support the concentrated loads.
4. For Branch Piping Runs and Runouts Over 5 feet In Length: Install a minimum of one hanger, and additional hangers if required by the hanger spacing schedules.
5. Parallel Piping Runs: Where several pipe lines run parallel in the same plane and in close proximity to each other, trapeze hangers may be used. Base hanger spacing for trapeze type hangers on the smallest size of pipe being supported. Design the entire hanger assembly based on a safety factor of five, for the ultimate strength of the material being used.

F. Size hanger rods in accordance with the following

PIPE SIZE (Inches)	SINGLE ROD HANGER SIZE (Inches)		DOUBLE ROD HANGER SIZE (Inches)	
	PIPE	TUBING	PIPE	TUBING
1/2 to 2	3/8	1/4	3/8	1/4
2-1/2 and 3	1/2	3/8	3/8	1/4
4 and 5	5/8	1/2	1/2	3/8
6	3/4	1/2	5/8	1/2
8, 10 and 12	7/8	5/8	3/4	5/8

1. Secure hanger rods as follows: Install one (1) nut under clevis, angle or steel member; one (1) nut on top of clevis, angle or steel member; one (1) nut inside insert or on top of upper hanger attachment and one (1) nut and washer against insert or on lower side of upper hanger attachment. A total of four (4) nuts are required for each rod, two (2) at upper hanger attachment and two (2) at hanger.
2. Size hanger rods, for piping over 12 inches in size and multiple line supports, based on a safety factor of five for the ultimate strength of the materials being used.

G. Vertical Piping

1. Support vertical risers of piping systems, by means of heavy duty hangers installed close to base of pipe risers, and by riser clamps with extension arms at intermediate floors, with the distance between clamps not to exceed 25 feet, unless otherwise specified. Support pipe risers in vertical shafts equivalent to the aforementioned. Install riser clamps above floor slabs, with the extension arms resting on floor slabs. Provide adequate clearances for risers that are subject to appreciable expansion and contraction, caused by operating temperature ranges.

2. Support extension arms of riser clamps, secured to risers to be insulated for cold service, 4 inches above floor slabs, to allow room for insulating and vapor sealing around riser clamps.
 3. Support cast iron risers, by means of heavy duty hangers installed close to the base of the pipe risers, and 1/4 inch thick malleable iron or steel riser clamps with extension arms at each floor level, with the distance between clamps not to exceed 25 feet. Support cast iron risers in vertical shafts equivalent to the aforementioned.
 4. Support hubless cast iron risers, by means of heavy duty hangers installed close to the base of the pipe risers, and by malleable iron or steel riser clamps with the extension arms at each floor level, with the distance between clamps or intermediate supports not to exceed 12 feet. Support risers in vertical shafts equivalent to the aforementioned.
- H. Floor Supports: Install adjustable yoke rests with base flanges, for the support of piping, unless otherwise indicated on the Drawings. Install supports in a manner, which will not be detrimental to the building structure.
- I. Underground Cast Iron Pipe Supports: Firmly bed pipe laid underground, on solid ground along bottom of pipe. Install masonry piers for pipe laid in disturbed or excavated soil or where suitable bearing cannot be obtained. Support pipe, laid proximate to building walls in disturbed or excavated soil, or where suitable bearing cannot be obtained, by means of wall brackets or hold-fasts secured to walls in an approved manner.

3.2 UPPER HANGER ATTACHMENTS

- A. General
1. Secure upper hanger attachments to overhead structural steel, steel bar joists, or other suitable structural members.
 2. Do not attach hangers to steel decks that are not to receive concrete fill.
 3. Do not attach hangers to precast concrete plank decks less than 2-3/4 inches thick.
 4. Do not use flat bars or bent rods as upper hanger attachments.
- B. Attachment to Steel Frame Construction: Provide intermediate structural steel members where required by pipe support spacing. Select steel members for use as intermediate supports based on a minimum safety factor of five.
1. Do not use drive-on beam clamps.
 2. Do not support piping over 4 inches in size from steel bar joists. Secure upper hanger attachments to steel bar joists at panel points of joists.
 3. Do not drill holes in main structural steel members.
 4. Beam clamps, with tie rods as specified, may be used as upper hanger attachments for the support of piping, subject to clamp manufacturer's recommended limits.
- C. Attachment to Concrete Filled Steel Decks
1. New Construction: Install metal deck ceiling bolts.

2. Existing Construction: Install welding studs (except at roof decks). Do not support a load in excess of 250 lbs from any single welded stud.
3. Do not attach hangers to decks less than 2-1/2 inches thick.

D. Attachment to Hollow Block or Hollow Tile Filled Concrete Decks

1. New Construction: Omit block or tile and pour solid concrete with cast-in-place inserts.
2. Existing Construction: Break out block or tile to access, and install machine bolt anchors at highest practical point on side of web.

E. Attachment to Wood Construction: Secure hangers to the sides (only) of wood members, by means of malleable iron side beam connectors, or malleable iron or steel side beam brackets. Do not secure hanger attachments to nailing strips resting on top of steel beams.

1. Secure side beam connectors to wood members with two (2) No.18 x 1-1/2 inch long wood screws, or two (2) No.16 x 1-1/2 inch long drive screws. Do not support piping over 1-1/2 inches in size from side beam connectors. Do not hammer in wood screws.
2. Secure side beam brackets to wood members with steel bolts or lag screws. Do not use lag screws in wooden members having a nominal thickness (beam face) under two (2) inches in size. Install bolts or lag screws, in the sides of a timber or a joist, at the mid-point or above, not less than 2-1/2 inches from the lower edge when supporting branch lines and not less than three (3) inches from the lower edge when supporting mains. Install heavy gauge steel washers under all nuts.
3. Secure side beam brackets to wooden beams or joists, with lag screws or bolts of size as follows:

PIPE SIZE (Inches)	LAG SCREW SIZE (Inches)	BOLT DIAMETER (Inches)
2 and under	3/8 diameter x 1-3/4	3/8
2-1/2 and 3	1/2 diameter x 2	1/2
4 and 5	Use Bolt	5/8

- a. Do not support piping larger than 3 inches with lag screws. Pre-drill holes for lag screws 1/8 inch in diameter less than the root diameter of the lag screw thread.
- b. The minimum width of the lower face of wood beams or joints in which lag screws of size as specified may be used is as follows:

LAG SCREW DIAMETER (Inches)	NOMINAL WIDTH OF BEAM FACE (Inches)
3/8	2
1/2	3

4. Do not secure hanger attachment to the diagonals or vertical members of the trusses.

3.3 ANCHORS, RESTRAINTS, RIGID SUPPORTS, STAYS AND SWAY BRACES

- A. Install pipe anchors, restraints and sway braces, at locations noted on the Drawings. Design anchors so as to permit piping to expand and contract freely in opposite directions, away from anchor points. Install anchors independent of all hangers and supports, and in a manner that will not affect the structural integrity of the building.

B. Cast Iron Soil Piping Systems

1. Where piping is suspended on centers in excess of 18 inches by means of non-rigid hangers, provide sway braces, of design, number and location in accordance with the Cast Iron Soil Pipe Institute's Cast Iron Soil Pipe and Fittings Handbook to prevent horizontal pipe movement.
2. Additionally, brace piping five (5) inches and larger to prevent horizontal movement and/or joint separation. Provide braces, blocks, rodding or other suitable method at each branch opening, or change of direction in accordance with the Cast Iron Soil Pipe Institute's Cast Iron Soil Pipe and Fittings Handbook to prevent horizontal pipe movement.

3.4 COMBINATION CLEVIS HANGER, PIPE INSULATION SHIELD AND VAPOR BARRIER JACKETED HIGH DENSITY INSULATING SADDLES

- A. Install a combination clevis hanger, pipe insulation shield and vapor barrier jacketed high density insulating saddles, at all points of support for piping or tubing to be insulated for cold service. Furnish companion high density vapor barrier jacketed saddle pieces, of the same material, thickness and length, for installation over the top 180 degree surface of pipe or tubing, at each point of support where an insulated clevis hanger is utilized.

3.5 PIPE INSULATION SHIELDS

- A. Unless otherwise specified, install a pipe insulation shield, at all points of support. Center shields on all hangers and supports outside of high density insulation insert, and install in such a manner so as not to cut, or puncture jacket.

3.6 ROOFTOP SUPPORT SYSTEM

- A. Install in accordance with manufacturer's instructions and recommendations.
- B. Provide complete and adequate support of all piping and equipment.
- C. The use of wood blocks for supporting piping or equipment is not permitted.
- D. If gravel top roof, gravel must be removed around and under support.
- E. Consult roofing manufacturer for roof membrane compression capacities. If necessary, a compatible sheet of roofing material (isolation pad) may be installed under rooftop support to disperse concentrated loads and add further membrane protection.
- F. Use properly sized clamps to secure piping or equipment.

END OF SECTION

SECTION 23 0553 - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the following Equipment Identification indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Items to be labeled
 - 1. Plumbing and Piping Valves
 - 2. Piping
 - 3. Equipment (Including but not limited to the following)
 - a. Air Handling Units (RTU, Makeup Air Units)
 - b. Fans
 - c. Terminal Devices (Cabinet Heater, Unit Heater)
 - d. Pumps
 - 4. Thermostats

1.2 REFERENCES

- A. ANSI A13.1 - Scheme for Identification of Piping Systems.

1.3 SUBMITTALS

- A. Product Data
 - 1. Manufacturer's catalog sheets and specifications for mechanical identification materials.
 - 2. Installation instructions.
 - 3. Schedule indicating what type of materials will be used for various equipment, valves, piping, and devices.

PART 2 - PRODUCTS

2.1 EQUIPMENT TAGS

- A. Aluminum Nameplates: Black enamel background with natural aluminum border and engraved letters furnished with two mounting holes and screws.
- B. Plastic Tags: 1/16" thick, UV resistant phenolic plastic. Minimum 1-1/2" square or round laminated with engraved, 1/4" minimum black letters on light contrasting background.
- C. Tags shall be black with white lettering.

- D. Lettering: Lettering shall be supplier's normal font, minimum 1" high

2.2 VALVE TAGS

- A. Brass Tags: 1-1/2" Round 19 gauge brass tags with 1/4" minimum engraved letters.
- B. Plastic Tags: 1/16" thick, UV resistant phenolic plastic. 1-1/2" round laminated with engraved, 1/4" minimum black letters on light contrasting background.
- C. Tags shall be brass or white with solid black lettering.
- D. Provide with brass ball chain or plastic zip connectors to attach tag to valve

2.3 PIPE MARKERS AND ACCESSORIES

- A. Snap-on Marker: One (1) piece wrap around type constructed of pre-coiled acrylic plastic with clear polyester coating, integral flow arrows, legend printed in alternating directions, 3/4 inch adhesive strip on inside edge, and 360 degree visibility.
- B. Strap-On Marker: Strip type constructed of pre-coiled acrylic plastic with clear polyester coating, integral flow arrows, legend printed in alternating directions, factory applied grommets, and pair of stainless steel spring fasteners.
- C. Stick-On Marker: Pressure sensitive adhesive backed type constructed of vinyl with clear polyester coating, and integral flow arrows for applications where flow arrow banding tape is not being used.
- D. Underground Marker: 6" wide, thickness depends on type. Provide detectable type for non-metallic piping such as plastic gas, water main, or underground PVC piping.
- E. Pipe Marker Legend and Color Field Sizes:

OUTSIDE DIAMETER OF PIPE OR INSULATION (Inches)	LETTER SIZE (Inches)	LENGTH OF COLOR FIELD (Inches)
3/4 to 1-1/4	1/2	8
1-1/2 to 2	3/4	8
2-1/2 to 6	1-1/4	12
8 to 10	2-1/2	24
Over 10	3-1/2	32

- F. Banding Tapes: Pressure sensitive adhesive backed type constructed of vinyl with clear polyester coating.
1. Plain Tape: Unprinted type; color to match pipe marker background.
 2. Flow Arrow Tape: Printed type with integral flow arrows; color to match pipe marker background.
- G. Pipe Size Labels: Pressure sensitive adhesive backed type constructed of vinyl with clear polyester coating, vertical reading pipe size in inches, and legend size matching adjacent pipe marker.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Complete testing, insulation and finish painting work prior to completing the Work of this Section.
- B. Clean pipe surfaces with cleaning solvents prior to installing piping identification.
- C. Remove dust from insulation surfaces with clean cloths prior to installing piping identification.

3.2 PIPING IDENTIFICATION

- A. Install the Work of this Section in accordance with the manufacturer's printed installation instructions, unless otherwise specified.
- B. Stick-On Pipe Markers:
 - 1. Install minimum of two (2) markers at each specified location, 90 degrees apart on visible side of pipe.
 - 2. Encircle ends of pipe markers around pipe or insulation with banding tape with one inch lap. Use plain banding tape on markers with integral flow arrows, and flow arrow banding tape on markers without integral flow arrows.
- C. Pipe Size Labels: Install labels adjacent to each pipe marker and upstream from flow arrow. Install a minimum of two (2) pipe size labels at each specified location, 90 degrees apart on visible side of pipe.
- D. Underground Pipe Markers: Install 8-12" above buried piping. Install along entire length of pipe.

3.3 PIPING IDENTIFICATION SCHEDULE

- A. Piping Identification Types

Piping:	Field Color:	Lettering Color:
Domestic Water	Green	White
Sanitary, Vent, Condensate, Drain	Green	White
Natural Gas	Yellow	Black

- B. Locate piping identification as follows:
 - 1. Locate piping identification at valve locations; at points where piping enters and leaves a partition, wall, floor or ceiling, and at intervals of 20 feet on straight runs.
 - 2. Where two (2) or more pipes run in parallel, place printed legend and other markers in same relative location.

3.4 EQUIPMENT IDENTIFICATION

- A. Install engraved tags on equipment using metal rivets or stainless steel sheet metal screws with a pan head. For indoor equipment, industrial strength double-sided tape is acceptable if rivets or screws cannot be used. Install label on most visible side of equipment. Place identification along center line of equipment, if possible.
- B. Label all mechanical equipment using the same callout as used on the drawings, by means of engraved tags.
- C. Do not label equipment in exposed public spaces, e.g. cabinet unit heaters, diffusers, louvers, etc.
- D. Label thermostats with the corresponding equipment served.

3.5 VALVE TAGS

- A. Valve tags shall be engraved with the following information:
 - 1. Service Abbreviation
 - 2. Valve number
- B. Service Abbreviation shall match piping nomenclature used on Drawings.
- C. Attach tags to valves, not valve handles or wheels.
- D. Trim excess from connecting strip or chain.
- E. Valve Schedule
 - 1. Provide a valve schedule that lists all valves not installed for individual plumbing fixtures. Valve schedule shall list the following information in order: service, tag number, size, usage (shut-off, balancing, control, etc.), name and number or room location, normally open or closed, pressure rating, manufacturer, model number, and installation date.
 - 2. Provide three (3) laminated hard copies and one (1) electronic copy in .pdf format. Hard copies shall be clearly legible and a minimum of 11" x 17".
 - 3. Mount one (1) of the hard copies in a solid metal frame in a location designated by the Owner.

3.6 SPECIAL CONDITIONS

- A. Additional labels shall be installed at the request of the Engineer/Owner.

END OF SECTION

SECTION 23 0593 - CLEANING AND TESTING

PART 1 - GENERAL

1.1 SCOPE

- A. Cleaning of systems to remove construction debris and prepare for testing and operation.
- B. Perform testing on systems and equipment to confirm they can withstand normal operating and design conditions as outlined in various equipment sections.
- C. Equipment Included in This Section
 - 1. Natural gas piping
 - 2. Domestic water piping

1.2 REFERENCES

- A. Balancing of Systems: Section 230594.

1.3 SUBMITTALS

- A. Quality Control Submittals
 - 1. Submit Field Test Reports for all systems to be tested.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements
 - 1. Perform factory testing of factory fabricated equipment in complete accordance with the agencies having jurisdiction.
 - 2. Perform field testing of piping systems in complete accordance with the local utilities and other agencies having jurisdiction and as specified.

1.5 PROJECT CONDITIONS

- A. Protection: During test Work, protect controls, gages and accessories which are not designed to withstand test pressures. Do not utilize permanently installed gauges for field testing of systems.

1.6 SEQUENCING AND SCHEDULING

- A. Transmit written notification of proposed date and time of operational tests to the Architect / Engineer at least five (5) days in advance of such tests.
- B. Perform cleaning and testing Work in the presence of the Owner's Representative.

- C. Pressure test piping systems inside buildings, at the roughing-in stage of installation, before piping is enclosed by construction Work, and at other times as directed. Perform test operations in sections as required and directed, to progress the Work in a satisfactory manner and not delay the general construction of the building. Valve or cap-off sections of piping to be tested, utilizing valves required to be installed in the permanent piping systems or temporary valves or caps as required to perform the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Test Equipment and Instruments: Type and kind as required for the particular system under test.
- B. Test Media (air, gas, refrigerant, dry nitrogen, vacuum, water): As specified for the particular piping or system under test.
- C. Cleaning Agent (chemical solution, steam, water): As specified for the particular piping, apparatus or system being cleaned.

PART 3 - EXECUTIONPRELIMINARY WORK

- A. Thoroughly clean pipe and tubing prior to installation. During installation, prevent foreign matter from entering systems. Prevent if possible and remove stoppages or obstructions from piping and systems.

3.2 PRESSURE TESTING OF PIPING

- A. Piping shall be tight under test and shall not show loss in pressure or visible leaks, during test operations or after the minimum duration of time as specified. Remove piping which is not tight under test; remake joints and repeat test until no leaks occur.
- B. Water Systems
 - 1. Domestic water (potable cold, domestic hot and recirculation) inside buildings:
 - a. Before fixtures, faucets, trim and accessories are connected, perform hydrostatic test at 125 psig minimum for four (4) hours.
 - b. After fixtures, faucets, trim and accessories are connected, perform hydrostatic retest at 75 psig for four (4) hours.
- C. Gas Piping: Before backfilling or concealment perform air test of duration and pressure as required by the local gas company. However, for gas piping designed for pressures of from 4 inches to 6 inches water column, air test at 15 inches Hg for one (1) hour, without drop in pressure. Test gas piping with air only. Check joints for leaks with soap suds.

3.3 TESTING OF EQUIPMENT, APPARATUS AND APPURTENANCES

- A. Relief Valves: Increase pressure in equipment or apparatus to relief valve setting, to test opening of valves at required relief pressures.

3.4 DISINFECTION OF POTABLE WATER SYSTEMS

- A. Disinfect potable water pipe and equipment installed in the Work of this Contract.
 - 1. Completely fill the piping, including water storage equipment if installed, with a water solution containing 50 mg/L available chlorine, and allow stand for twenty-four (24) hours.
 - 2. Operate all valves during this period to assure their proper disinfection.
 - 3. After the retention period, discharge the solution to an approved waste and flush the system thoroughly with water until substantially all traces of chlorine are removed.
 - 4. Drain and flush water storage equipment if installed.
- B. Connect plumbing fixtures and equipment and place the system into service. Prevent recontamination of the piping during this phase of the Work.

END OF SECTION

SECTION 23 0594 – TESTING ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required for complete Testing, Adjusting and Balancing of the systems as indicated by the Contract Documents with supplementary items necessary for proper system operation.
- B. Equipment included in This Section
 - 1. Air Handling Equipment
 - a. Rooftop air handling units
 - b. Makeup air handling units
 - c. Exhaust fans
 - d. Air inlets and outlets
 - 2. Plumbing Equipment
 - a. Hot water circulation pump
 - b. Hot water circulation branch balancing valves

1.2 SUBMITTALS

- A. Certified TAB reports

1.3 QUALITY ASSURANCES

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB, or TABB.
 - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB, or TABB.
 - 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB, or TABB as a TAB technician.

1.4 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.5 PROJECT CONDITION

- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations

1.6 COORDINATION

- A. Notice: Provide seven (7) days advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.7 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent
 - 2. Air Outlets and Inlets: Plus or minus 10 percent

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

- A. Subject to compliance with requirements, engage one (1) of the following
 - 1. Precision Facility Solutions
 - 2. System Management and Balance
 - 3. System Works

3.2 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

- E. Examine ceiling plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Metal Ductwork" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design". Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- L. Examine system pumps to ensure absence of entrained air in the suction piping.
- M. Examine operating safety interlocks and controls on HVAC equipment.
- N. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Automatic temperature-control systems are operational.
 - 3. Equipment and duct access doors are securely closed.
 - 4. Balancing dampers are open.
 - 5. Isolating and balancing valves are open and control valves are operational.

6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
7. Windows and doors can be closed so indicated conditions for system operations can be met.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in this specification and one of the following:
 1. AABC's "National Standards for Total System Balance"
 2. ASHRAE 111
 3. NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems"
 4. SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing"
- B. Comply with requirements of the adopted version of ASHRAE 62.1, Section on balancing.
- C. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation".
- D. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- E. Take and report testing and balancing measurements in inch-pound (IP).

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- C. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- D. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- E. Verify that motor starters are equipped with properly sized thermal protection.
- F. Check dampers for proper position to achieve desired airflow path.

- G. Check for airflow blockages.
- H. Check condensate drains for proper connections and functioning.
- I. Check for proper sealing of air-handling-unit components.
- J. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ductwork."

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - 2. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow
 - 3. Measure fan static pressures as follows to determine actual static pressure:
 - 4. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - 5. Measure static pressure a few feet downstream of a fan or in a location that will avoid turbulent or unrepeatable performance.
 - 6. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - 7. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 8. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - 9. Report the cleanliness status of filters and the time static pressures are measured.
 - 10. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 - 11. Balancer can adjust fan speeds 15% higher or lower than speed indicated in the approved shop drawing to meet the required capacity. If a fan needs to operate outside these parameters to meet the capacity requirements, balancer to contact the Engineer for approval. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance
 - 12. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

- B. Adjust volume dampers for main duct, sub-main ducts, and major branch ducts to indicated airflows within specified tolerances.
 - 1. Measure airflow of sub-main and branch ducts.
 - 2. Where sufficient space in sub-main and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 - 3. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 - 4. Re-measure each sub-main and branch duct after all have been adjusted. Continue to adjust sub-main and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
 - 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
 - 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 - 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer's name, model number, and serial number.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.8 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each electric heating coil:
 - 1. Nameplate data
 - 2. Airflow
 - 3. Entering- and leaving-air temperature at full load
 - 4. Voltage and amperage input of each phase at full load and at each incremental stage
 - 5. Calculated kilowatt at full load
 - 6. Fuse or circuit-breaker rating for overload protection
- B. Measure, adjust, and record the following data for each refrigerant coil:
 - 1. Dry-bulb temperature of entering and leaving air
 - 2. Wet-bulb temperature of entering and leaving air
 - 3. Airflow
 - 4. Air pressure drop

3.9 FINAL REPORT

- A. General: Prepare a certified written report;
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Pump curves
 - 2. Fan curves
 - 3. Manufacturers' test data
 - 4. Field test reports prepared by system and equipment installers
 - 5. Other information relative to equipment performance; do not include Shop Drawings and product data
- C. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page
 - 2. Name and address of the TAB contractor

3. Project name
 4. Project location
 5. Architect's name and address
 6. Engineer's name and address
 7. Contractor's name and address
 8. Report date
 9. Signature of TAB supervisor who certifies the report
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 - d. Nomenclature sheets for each item of equipment.
 - e. Data for terminal units, including manufacturer's name, type, size, and fittings.
 - f. Notes to explain why certain final data in the body of reports vary from indicated values.
 12. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Settings for supply-air, static-pressure controller.
 - g. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Duct, outlet, and inlet sizes.
 3. Pipe and valve sizes and locations.
 4. Balancing stations.
 5. Position of balancing devices.

3.10 INSPECTIONS

- A. Initial Inspection

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
 2. Check the following for each system:
 - a. Measure airflow of at least ten (10) percent of air outlets.
 - b. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - c. Verify that balancing devices are marked with final balance position.
 - d. Note deviations from the Contract Documents in the final report.
- B. Final Inspection
1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by the Owner's Representative.
 2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Owner's Representative.
 3. Owner's Representative shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal eight (8)-hour business day.
 4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
 5. If the number of "FAILED" measurements is greater than ten (10) percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.
- D. Prepare test and inspection reports.

3.11 ADDITIONAL TESTS

- A. Within ninety (90) days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 0713 - DUCTWORK INSULATION

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the following Ductwork Insulation indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Equipment Included in This Section
 - 1. Insulation
 - 2. Fasteners
 - 3. Jacketing
 - 4. Sealants

1.2 REFERENCES

- A. Ductwork schedules located on Drawings.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed in the following references:
 - 1. NFPA 90
 - 2. ASTM
- C. Abbreviations
 - 1. K: Thermal Conductivity, in Btu per inch thickness per hour per square foot.
 - 2. PVC: Polyvinylchloride

1.3 SUBMITTALS

- A. Product Data
 - 1. Manufacturer's catalog sheets and specifications for insulation materials and jacket materials.
 - 2. Materials Schedule: Itemize insulation materials and thicknesses for each specified application in Insulation Material Schedules in Part 3 of this Section. Where optional materials are specified, indicate option selected. Schedule should be similar to Ductwork schedule on Drawings.

1.4 QUALITY ASSURANCE

- A. Qualifications: The persons installing the Work of this Section and their Supervisor shall be personally experienced in mechanical insulation work and shall have been regularly employed by a company installing mechanical insulation for a minimum of five (5) years.
- B. Regulatory Requirements
 - 1. Insulation installed inside buildings, including duct lining materials, laminated jackets, mastics, sealants and adhesives shall have a Fire Spread/Smoke Developed Rating of 25/50 or less based on ASTM E 84.

PART 2 - PRODUCTS

2.1 ADHESIVES

- A. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Calcium Silicate Adhesive: fibrous, sodium-silicate-based adhesive with a service temperature range of 50° F - 800° F (10° C - 427° C).
- C. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of -75° F to +300° F (-59° C to +149° C).
- D. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, class 2, Grade A.
- F. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- G. PVC Jacket Adhesive: Compatible with PVC jacket.

2.2 MASTICS

- A. For indoor applications, use mastics that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

2.3 LAGGING ADHESIVES

- A. For indoor applications, use adhesive that has a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

2.4 JACKETS

A. PVC Jackets

1. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness: 0.030".
2. Adhesive: As recommended by jacket material manufacturer.
3. 3. Color: [White] [Color-code jackets based on system. Color as selected by Architect].

B. Stainless Steel Jackets:

1. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
2. Type 304 or Type 316 sheet and roll stock ready for shop or field sizing. Material thickness: 0.030".
3. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and 2.5mil- thick polysurlyn.

C. Aluminum Jackets:

1. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
2. Moisture Barrier for Outdoor Applications: 3-mil thick, heat-bonded polyethylene.

D. Self-Adhesive Outdoor Jackets:

1. Self-Adhesive Outdoor Jacket: 60-mil thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with [white] [stucco-embossed] aluminum-foil facing.

2.5 BANDING

- A. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316 as required to match jacketing material; 0.015 inch thick, 3/4 inch wide with wing seals.
- B. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seals.

2.6 SEALANTS

- A. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 INSULATION

- A. Ductwork Insulation Types
 - 1. Type A: Flexible fiberglass duct wrap. Minimum density 0.75 #/ft³, K of 0.30 at 75° F; ASTM C 553, Type II.
 - 2. Type B: Semi-rigid fiberglass board wrap. Minimum density 3.0 #/ft³, K of 0.23 at 75° F; ASTM C612, Type IA.
 - 3. Type C: Flexible fiberglass duct liner. Minimum density 3.0 #/ft³, K of 0.24 at 75° F; ASTM C 1071. Liner between insulation and airstream side of double-wall ductwork shall have a Fire Spread/Smoke Developed Rating of 25/50 or less based on ASTM E 84.
 - 4. Type D: Preformed rigid fiberglass duct liner. Minimum density 3.0 #/ft³, K of 0.23 at 75°F; ASTM C 1071. Liner shall have a Fire Spread/Smoke Developed Rating of 25/50 or less based on ASTM E 84
 - 5. Type E: Flexible mineral fiber duct wrap (Suitable for Temperatures Up to 1800° F). Minimum density 6 #/ft³; ASTM E 2336, NFPA 96-2011, UL 1978 (Rev. 6-02). Two (2)-hour fire separation rating with zero clearance to combustibles. Thickness shall be as specified or as required by AHJ to meet fire separation requirements.
 - 6. Type F: Flexible fiberglass duct liner for spiral ductwork. Minimum density 3.0 #/ft³, K of 0.23 at 75° F; Liner shall have a Fire Spread/Smoke Developed Rating of 25/50 or less based on ASTM E 84.
- B. Fire resistant, anti-erosion, and anti-microbial coating on lining interior to duct; NFPA 90-A and 90-B.
- C. All insulation densities listed are minimum densities. Contractor shall be responsible for verifying the required insulation thickness & density to meet the minimum installed insulation R-values as listed in the ductwork schedules on the drawings.

PART 3 - EXECUTION

3.1 DUCT INSULATION SCHEDULE

- A. Refer to Ductwork Application Schedule on Drawings for insulation requirements.

3.2 PREPARATION

- A. Perform the following before starting insulation work.
 - 1. Install hangers, supports and appurtenances in their permanent locations.
 - 2. Complete testing of piping, ductwork, and equipment.

3. Clean and dry surfaces to be insulated.

3.3 INSTALLATION, GENERAL

- A. Install the work of this section in accordance with the manufacturer's printed installation instructions unless otherwise specified.

3.4 INSTALLATION AT HANGERS AND SUPPORTS

- A. Reset and realign hangers and supports if they are displaced while installing insulation.
- B. Insulation inserts for use with fibrous glass insulation:
 1. Ductwork: Install 6 #/ft³ density jacketed fibrous glass board, same thickness as adjoining insulation, sized for full bearing on supporting trapeze member, and as required to enable abutting to adjoining insulation and overlapping of jacketing.

3.5 INSTALLATION OF DUCTWORK INSULATION

- A. Exterior to Ductwork
 1. Cut insulation to stretch-out dimensions as recommended by insulation manufacturer.
 2. Remove two (2) inch wide strip of insulation material from the jacketing on the longitudinal and circumferential joint edges to form an overlapping staple/tape flap.
 3. Install insulation with jacketing outside so staple/tape flap overlaps insulation and jacketing on other end.
 4. Butt ends of insulation tightly together.
 - a. Rectangular and Square Ductwork: Do not compress insulation at duct corners.
 5. Staple longitudinal and circumferential joints with outward clinching staples minimum six (6) inches on center, and seal with pressure sensitive sealing tape.
 6. Cut off protruding ends of fasteners flush with insulation surface and seal with pressure sensitive sealing tape.
 7. Install duct insulation fasteners on bottom side of horizontal duct runs, when bottom dimension of the duct is in excess of 24 inches in width.
 8. Install duct insulation fasteners on sides of duct risers having a dimension over 24 inches in size.
 9. Seal tears, punctures, and penetrations of insulation jacketing with sealing tape.
- B. Interior to Ductwork
 1. Insulate ducts prior to erection in place when ducts are required to be installed proximate to walls, ceilings, equipment or other ductwork, which will not permit adequate space for installation of insulation after ducts are installed.

2. Line interior surfaces of ducts with thermal and acoustic board insulation, when the specified application of exterior insulation is impractical.
 - a. Written permission from the Engineer must be received, prior to the substitution of lined ducts for exterior insulated ducts.
 - b. Maintain interior cross-sectional areas of ducts, as noted on drawings.

3.6 INSTALLATION OF JACKETING MATERIAL

A. PVC Jackets:

1. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
2. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

B. Metal Jackets:

1. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.7 FIELD QUALITY CONTROL

- #### **A. Field Samples:** The Director's Representative, may at his discretion, take field samples of installed insulation for the purpose of checking materials and application. Reinsulate sample cut areas.

3.8 DUCTWORK SERVICE INSULATION SCHEDULE

- #### **A. Insulate all ductwork except where otherwise specified. See Ductwork schedule on Drawings.**

B. Notes

1. Equipment: Insulate air handling equipment, not furnished with factory applied insulated jacket or internal insulation, with minimum 1-1/2 inch thick fibrous glass board with an ASTM C 1136 Type I jacket, installed and finished as specified for exposed ductwork in finished spaces.

END OF SECTION

SECTION 23 0719 - PIPING INSULATION

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the Piping Insulation indicated by the Contract Documents with supplementary items necessary for proper installation.

1.2 REFERENCES

- A. Pipe Hangers and Supports: Section 230529.
- B. Abbreviations
 - 1. K: Thermal Conductivity, i.e., maximum Btu per inch thickness per hour per square foot.
 - 2. pcf: Pounds per cubic foot.
 - 3. PVC: Polyvinylchloride.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's catalog sheets and specifications for the following:
 - 1. Insulation Materials.
 - 2. Jacket Materials.
 - 3. Sealant and Adhesive Materials.

1.4 QUALITY ASSURANCE

- A. Qualifications: The person(s) directly supervising the installation of this work in the field shall be personally experienced in mechanical insulation work and shall have been regularly employed by a company installing mechanical insulation for a minimum of five (5) years.
- B. Regulatory Requirements
 - 1. Insulation installed inside buildings, including laminated jackets, mastics, sealants and adhesives shall have a Fire Spread/Smoke Developed Rating of 25/50 or less based on ASTM E 84.
 - 2. Insulation shall meet minimum requirements ASHRAE 90.1-2007.

PART 2 - PRODUCTS

2.1 PIPING INSULATION

- A. Fibrous Glass (Mineral Fiber) Insulation: Composed principally of fibers manufactured from rock, slag, or glass, with or without binders, and asbestos free.
 - 1. Preformed Pipe Insulation: Minimum density 3 pcf; ASTM C 547
 - a. Class 1 (Suitable for Temperatures Up to 450° F): K of 0.26 at 75° F.
 - 2. Premolded Fitting Insulation: Minimum density 4.0 pcf, K of 0.26 at 75° F; ASTM C 547, Class 1.
 - 3. Insulation Inserts for PVC Fitting Jackets: Minimum density 1.5 pcf, K of 0.28 at 75° F; ASTM C 553, Type III. Suitable for temperatures up to 450° F.
- B. Flexible Elastomeric Foam Insulation
 - 1. FM tested and approved, meeting the following:
 - a. Maximum Water Vapor Transmission: 0.10 perm - inch based on ASTM E 96, Procedure A.
 - b. K of 0.27 at 75° F based on ASTM C 518 or C 177.
 - 2. Pipe Insulation: ASTM C 534, Type I.
 - 3. Polyethylene and polyolefin insulation is not acceptable.
- C. High Density Jacketed Insulation Inserts for Hangers and Supports
 - 1. For Use with Fibrous Glass Insulation:
 - a. Cold Service Piping:
 - 1) Polyurethane Foam: Minimum density 4 pcf, K of 0.13 at 75° F, minimum compressive strength of 125 psi.
 - b. Hot Service Piping:
 - 1) Calcium Silicate: Minimum density 15 pcf, K of 0.50 at 300° F; ASTM C 533.
 - 2) Perlite: Minimum density 12 pcf, K of 0.60 at 300° F; ASTM C 610.
 - 2. For Use with Flexible Elastomeric Foam Insulation: Hardwood dowels and blocks, length or thickness equal to insulation thickness, other dimensions as specified or required.
- D. Cements
 - 1. Fibrous Glass Thermal Insulating Cement: Asbestos free; ASTM C 195.
 - 2. Fibrous Glass Hydraulic Setting Thermal Insulating and Finishing Cement: ASTM C 449/C 449M.

2.2 INSULATION JACKETS

- A. Laminated Vapor Barrier Jackets for Piping: Factory applied by insulation manufacturer, conforming to ASTM C 1136, Type I.

1. Type I: Reinforced white kraft and aluminum foil laminate with kraft facing out.
 - a. Pipe Jackets: Furnished with integral 1-1/2" self sealing longitudinal lap, and separate 3" wide adhesive backed butt strips.
 2. Laminated vapor barrier jackets are not required for flexible elastomeric foam insulation.
- B. Canvas Jackets: Cotton duck, fire retardant, NFPA 701 compliant, 4 or 6 oz. per square yard as specified.
- C. PVC Jackets and Premolded Fitting Covers
1. Constructed of high impact, UV resistant PVC. 0.020" 0.030" thickness.
 - a. ASTM D 1784, Class 14253-C.
 - b. Working Temperature: 0-150° F.
- D. Insulated Safety Wrap: Handi Lav-Guard by Truebro Inc., or Prior Approved Equal.
1. Construction: 1/8" thick chemical resistant vinyl with internal ribs.
 2. Fasteners: Nylon tie laces or reuseable clips.
 3. Kit includes covering for 8" tailpiece, P trap, 8" waste arm, hot and cold lines and valves, and required fasteners.

2.3 ADHESIVES, MASTICS, AND SEALERS

- A. Adhesives
1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D(EPA Method 24).
 2. Calcium silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 - 800° F (10 - 427° C).
 3. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive with a service temperature range of -75°F to +300°F (-59°C to +149°C)
 4. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 5. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 6. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 7. PVC Jacket Adhesive: Compatible with PVC jacket.
- B. Mastics
1. For indoor applications, use mastics that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D(EPA Method 24).
 2. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

C. Lagging Adhesives

1. For indoor applications, use adhesive that has a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D(EPA Method 24).
2. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

D. Sealants

1. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D(EPA Method 24).
2. Vapor Seal Adhesive (Fibrous Glass Insulation): Childers' CP-82, Epolux's Cadoprene 400, Foster's 85-75 or 85-20.
3. Vapor Barrier Mastic/Joint Sealer (Fibrous Glass Insulation): Childers' CP-30, Epolux's Cadalar 670, Foster's 95-44 or 30-35.
4. Adhesive (Flexible Elastomeric Foam): Armstrong's 520, Childers' CP-80, Epolux's Cadoprene 488, Foster's 82-40.
5. Sealant (Metal Pipe Jacket): One-part silicone sealant for high temperatures; Dow Corning's Silastic 736 RTV or General Electric's RTV 106.

2.4 MISCELLANEOUS MATERIALS

A. Pressure Sensitive Tape for Sealing Laminated Jackets:

1. Acceptable Manufacturers:
 - a. Alpha Associates
 - b. Childers
 - c. Ideal Tape
 - d. Morgan Adhesive
2. Type: Same construction as jacket.

B. Wire, Bands, and Wire Mesh:

1. Binding and Lacing Wire: Nickel copper alloy or copper clad steel, gauge as specified.
2. Bands: Galvanized steel, 1/2" wide x 0.015" thick, with 0.032" thick galvanized wing seals.
3. Wire Mesh: Woven 20-gauge steel wire with 1" hexagonal openings, galvanized after weaving.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform the following before starting insulation Work:

1. Install hangers, supports and appurtenances in their permanent locations.

2. Complete testing of piping.
3. Clean and dry surfaces to be insulated.

3.2 INSTALLATION, GENERAL

- A. Install the Work of this Section in accordance with the manufacturer's printed installation instructions unless otherwise specified.
- B. Provide continuous piping insulation and jacketing when passing thru interior wall, floor, and ceiling construction.
 1. At Through Penetration Firestops: Coordinate insulation densities with the requirements of approved firestop system being installed. See Section 078400.
 - a. Insulation densities required by approved firestop system may vary with the densities specified in this Section. When this occurs use the higher density insulation.
- C. Do not intermix different insulation materials on individual runs of piping.

3.3 INSTALLATION AT HANGERS AND SUPPORTS

- A. Reset and realign hangers and supports if they are displaced while installing insulation.
- B. Install high density jacketed insulation inserts at hangers and supports for insulated piping.
- C. Insulation Inserts For Use with Fibrous Glass Insulation
 1. Where clevis hangers are used, install insulation shields and high density jacketed insulation inserts between shield and pipe.
 - a. Where insulation is subject to compression at points over 180° apart, e.g. riser clamps, U-bolts, trapezes, etc.; fully encircle pipe with two (2) protection shields and two (2) high density jacketed fibrous glass insulation inserts within supporting members.
- D. Insulation Inserts For Use with Flexible Elastomeric Foam Insulation:
 1. Where clevis hangers are used, install insulation shields with hardwood filler pieces, same thickness as adjoining insulation, inserted in undersized die cut or slotted holes in insulation at support points.
 2. Contour hardwood blocks to match the curvature of pipe, and shield.
 3. Coat dowels and blocks with insulation adhesive, and insert while still wet.
 4. Vapor seal outer surfaces of dowels and blocks with adhesive after insertion.
 5. Install filler pieces as follows:

PIPE/TUBING SIZE	FILLER PIECES	POSITION
Thru 1-1/2"	2 dowel plugs	6 o'clock; in tandem
2" thru 4"	1 block, 2 dowel plugs	6 o'clock, and 4 & 8 o'clock respectively
6" thru 8"	2 blocks, 4 dowel plugs	6 o'clock; in tandem and 4 & 8 o'clock; in tandem

3.4 INSTALLATION OF FIBROUS GLASS COLD SERVICE INSULATION

- A. Install insulation materials with a field or factory applied ASTM C 1136 Type I laminated vapor barrier jacket, unless otherwise specified.
- B. Piping
 1. Butt insulation joints together, continuously seal minimum 1-1/2" wide self-sealing longitudinal jacket laps and 3" wide butt adhesive backed strips.
 - a. Substitution: 3" wide pressure sensitive sealing tape, of same material as jacket, may be used in lieu of butt strips.
 2. Bed insulation in a 2" wide band of vapor barrier mastic, and vapor seal exposed ends of insulation with vapor barrier mastic at each butt joint between pipe insulation and equipment, fittings or flanges at the following intervals:
 - a. Horizontal Pipe Runs: 21 ft.
 - b. Vertical Pipe Runs: 9 ft.
- C. Fittings, Valves, Flanges and Irregular Surfaces
 1. Piping Systems (less than 40° F)
 - a. Insulate with mitre cut or pre-molded fitting insulation of same material and thickness as pipe insulation.
 - b. Secure insulation in place with 16-gauge wire, with ends twisted and turned down into insulation.
 - c. Butt insulation against pipe insulation and bond with joint sealer.
 - d. Insulate valves up to and including bonnets, without interfering with packing nuts.
 - e. Insulate pump impeller casings on pump systems operating below 45° F.
 - f. Apply leveling coat of insulating cement to smooth out insulation and cover wiring.
 - g. When insulating cement has dried, seal fitting, valve and flange insulation, by imbedding a layer of reinforcing membrane between two (2) flood coats of vapor barrier mastic, each 1/8" thick wet.
 - h. Lap reinforcing membrane or canvas on itself and adjoining pipe insulation at least 2 inches.
 - i. Trowel, brush or rubber glove outside coat over entire insulated surface.
 2. Piping Systems (40 - 60° F)
 - a. Valves, fittings and flanges shall be insulated with pre-molded PVC fitting jackets, with fibrous glass insulation inserts.

- 1) Additional insulation inserts are required for services with operating temperatures under 45° F or where insulation thickness exceeds 1-1/2". The surface temperature of PVC fitting jacket must not go below 45° F.

3.5 INSTALLATION OF FIBROUS GLASS HOT SERVICE INSULATION

- A. Install insulation materials with field or factory applied ASTM C 1136 Type I laminated vapor barrier jacket unless otherwise specified.
- B. Piping
 1. Butt insulation joints together, continuously seal minimum 1-1/2" wide self-sealing longitudinal jacket laps and 3" wide adhesive backed butt strips.
 - a. Substitution: 3" wide pressure sensitive sealing tape, of same material as the jacket, may be used in lieu of butt strips.
 2. Fill voids in insulation at hanger with insulating cement.
 3. Exceptions:
 - a. Piping in Accessible Shafts, Attic Spaces, Crawl Spaces, Unfinished Spaces and Concealed Piping: Butt insulation joints together and secure minimum 1-1/2" wide longitudinal jacket laps and 3" wide butt strips of same material as jacket, with outward clinching staples on maximum 4" centers. Fill voids in insulation at hangers with insulating cement.
 - b. Piping in Tunnels: Butt insulation joints together and secure minimum 1-1/2" wide longitudinal jacket laps and 3" wide butt strips, of same material as jacket, with outward clinching staples on maximum 4" centers and 16 gauge wires a minimum of four (4) loops per section. Fill voids in insulation with insulating cement.
- C. Fittings, Valves, Flanges and Irregular Surfaces
 1. Insulate with mitre cut or pre-molded fitting insulation of same material and thickness as insulation.
 2. Secure in place with 16-gauge wire, with ends twisted and turned down into insulation.
 3. Butt fitting, valve and flange insulation against pipe insulation, and fill voids with insulating cement.
 4. Insulate valves up to and including bonnets, without interfering with packing nuts.
 5. Apply leveling coat of insulating cement to smooth out insulation and cover wiring.
 6. After insulating cement has dried, coat insulated surface with lagging adhesive, and apply 4 oz or 6 oz canvas jacket as required by pipe size.
 - a. Lap canvas jacket on itself and adjoining pipe insulation at least 2".
 - b. Size entire canvas jacket with lagging adhesive.
 7. Piping Systems (below 250° F)
 - a. Valves, fittings and flanges may be insulated with pre-molded PVC fitting jackets, with fibrous glass insulation inserts.
 - 1) The surface temperature of PVC fitting jacket not to exceed 150° F.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC FOAM INSULATION

- A. Where possible, slip insulation over the pipe, and seal butt joints with adhesive.
 - 1. Where the slip-on technique is not possible, slit the insulation and install.
 - 2. Re-seal with adhesive, making sure the mating surfaces are completely joined.
- B. Insulate fittings and valves with miter cut sections. Use templates provided by the manufacturer, and assemble the cut sections in accordance with the manufacturer's printed instructions.
 - 1. Insulate threaded fittings and valves with sleeved fitting covers. Overlap and seal the covers to the adjoining pipe insulation with adhesive.
- C. Carefully mate and seal with adhesive all contact surfaces to maintain the integrity of the vapor barrier of the system.
- D. Piping Exposed Exterior to a Building, Totally Exposed to the Elements:
 - 1. Apply flexible elastomeric foam insulation to piping with adhesive.
 - 2. Apply reinforcing membrane around piping insulation with adhesive or mastic.
 - 3. Adhesive Applied System: Apply two (2) coats of finish.
 - 4. Mastic Applied System: Apply another coat of mastic over reinforcing membrane.

3.7 INSTALLATION OF PVC JACKETING ON PIPING

- A. Secure jacketing to insulated piping and seal with adhesive. All seams shall be secured flat.
- B. Jacket fittings with preformed covers.

3.8 FIELD QUALITY CONTROL

- A. Field Samples: The Owner's Representative, may at his discretion, take field samples of installed insulation for the purpose of checking materials and application. Contractor shall reinsulate sample cut areas.

3.9 PIPING INSULATION SCHEDULE

- A. Refer to Piping Application Schedule on Drawings for Piping Insulation Schedule.
- B. Insulate all cold service and hot service piping, and appurtenances except where otherwise specified.
- C. Schedule of items not to be insulated:
 - 1. Do not insulate the following items:
 - a. Actual heat transfer surfaces.
 - b. Chromium plated piping, unless otherwise specified.
 - c. Flexible vibration eliminators.

- d. Water meters.
 - e. Drains from heating equipment and appurtenances that flow to waste.
 - f. Chemical feed piping.
 - g. Piping inside convector and finned tube radiation enclosures.
 - h. Boiler blow-off and blow-down piping.
 - i. Safety and relief valves. Discharge piping from relief valves.
 - j. Vent piping to atmosphere installed exposed in Mechanical Rooms, connected to the following: Blow-off tanks, flash tanks, condensate tanks.
 - k. Flanges and unions in piping systems over 140° F.
 - l. Hydronic Specialties: Flow indicators, control valves 3" and under, air vents and air control fittings.
 - m. Steam traps and cooling legs of steam traps.
 - n. Float chambers and level controllers.
- 2. Do not insulate mechanical equipment with a factory applied insulated steel jacket, unless specified otherwise.

D. Notes:

- 1. Insulate cold condensate drain piping connected to drain pans under cooling coils within unit enclosure, except where over drain pans:

3.10 SCHEDULE OF PVC JACKETING FOR INSULATED PIPE

- A. For exposed piping, install jacketing from floor to ceiling or from floor to first change of direction in riser, when such change in direction is a minimum of 9'-0" above finished floor, whichever is applicable.
- B. Jacket exposed insulated piping in mechanical rooms with PVC jacketing.

END OF SECTION

SECTION 23 0900 – DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the following HVAC Control System indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. The control system shall consist of a high-speed, peer-to-peer network of DDC controllers and an operator workstation or web server. The system shall control or monitor all equipment specified on the Contract Drawings. See the temperature controls responsibility matrix on the drawings.
- C. Equipment Included in This Section
 - 1. Products (not furnished or installed but integrated with the Work of this section)
 - a. Coordination Meeting: The Installer furnishing the DDC network shall meet with the Installer(s) furnishing mechanical equipment, VFD's, fire alarm, and controllers to coordinate details of the interface between these products and the DDC network. The Owner or his designated representative shall be present at this meeting. Each Installer shall provide the Owner and all other Installers with details of the proposed interface hardware and software identifiers for the interface points, network identifiers, wiring requirements, communication speeds, and required network accessories. The purpose of this meeting shall be to insure there are no unresolved issues regarding the integration of these products into the DDC network. Submittals for these products shall not be approved prior to the completion of this meeting.

1.2 REFERENCES

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents.
- B. Related Work
 - 1. Section 230500 - Common Work Results for HVAC
 - 2. Section 260500 - Common Work Results for Electrical
 - 3. Section 260523 – Control Cables
 - 4. Section 232923 or 262923 – Variable Frequency Drives
 - 5. Section 280000 - Electronic Safety and Security (includes Fire and Smoke)

1.3 SUBMITTALS

- A. Product Submittal Requirements: Provide copies of Shop Drawings and other submittals on hardware, software, and equipment to be installed or furnished. Begin no work until submittals have been approved for conformity with design intent. Provide drawings in .PDF format. When

manufacturer's cutsheets apply to a product series rather than a specific product, clearly indicate applicable data by highlighting or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cutsheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve Contractor of responsibility to supply sufficient quantities to complete work.

1. Direct Digital Control System Hardware

- a. Complete bill of materials indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.
- b. Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions.
- c. Diagrams indicating field sensor and controller locations.

2. Central System Hardware and Software

- a. Complete bill of material indicating quantity, manufacturer, model number, and relevant technical data of equipment used.
- b. Manufacturer's description and technical data such as product specifications and installation and maintenance instructions.
- c. Schematic diagrams of control, communication, and power wiring for central system installation. Show interface wiring to control system.

3. Controlled Systems

- a. Riser diagrams showing control network layout, communication protocol, and wire types.
- b. Schematic diagram of each controlled system. Label control points with point names. Graphically show locations of control elements.
- c. Instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.
- d. Complete description of control system operation including sequences of operation. Include and reference schematic diagram of controlled system. List I/O points and software points specified on Drawings. Indicate alarmed and trended points.
- e. Submittal of control sequences should include the actual control sequence proposed for this project, not a copy of the sequence included in the construction documents. If the actual sequence is not available during the initial submission of the shop drawings it can be issued for review during construction prior to equipment startup.

B. Control Point Integration List

1. Contractor to provide a master list of all control points for each piece of mechanical equipment with packaged controls.

C. Control Point Verification List

1. Contractor to provide a list containing all control points after substantial completion. The list shall include the following:
 - a. Operation of the control point was operating as needed per the contract documents / shop drawings.
 - b. Who verified the point operation.
 - c. Date and time of verification.

- D. Training Materials: Provide course outline and materials for each class at least four (4) weeks before first class.
- E. Project Record Documents. Submit three (3) copies of record (as-built) documents upon completion of installation for approval prior to final completion. Submittal shall consist of:
 - 1. Provide three (3) copies of project record drawings. As-built versions of submittal shop drawings provided on a USB flash drive (file format: .PDF) and prints of each drawing on 11" x 17" paper.
 - 2. Completed versions of reports, checklists, and trend logs used to meet requirements of Control System Demonstration and Acceptance Section.
 - 3. Operation and Maintenance (O&M) Manual: Printed, electronic, or online help documentation of the following:
 - a. As-built versions of submittal product data.
 - b. Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
 - c. Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.
 - d. Programming manual or set of manuals with description of programming language and syntax, statements for algorithms and calculations used, point database creation and modification, program creation and modification, and editor use.
 - e. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.
 - f. Documentation of programs created using custom programming language including setpoints, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, setpoints, tuning parameters, and objects can be viewed using furnished programming tools.
 - g. Graphic files, programs, and database on USB drive.
 - h. List of recommended spare parts with part numbers and suppliers.
 - i. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
 - j. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation or web server software, and graphics software.
 - k. Licenses, guarantees, and warranty documents for equipment and systems.
 - l. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.

1.4 QUALITY ASSURANCE

- A. Installer and Manufacturer Qualifications
 - 1. Installer shall have an established working relationship with Control System Manufacturer.
 - 2. Installer shall have successfully completed Control System Manufacturer's control system training. Upon request, Installer shall present record of completed training including course outlines.

B. Regulatory Requirements

1. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authorities' codes and ordinances or these plans and specifications.
 - a. Adopted version of the National Electric Code (NEC)
 - b. Adopted version of the International Building Code (IBC)
 - c. Adopted version of the International Mechanical Code (IMC)
 - d. ANSI/ASHRAE 135 (adopted version): Data Communication Protocol for Building Automation and Control Systems (BACNET)
 - e. Adopted version of the International Energy Conservation Code
 - f. ASHRAE 90.1 (adopted version): Energy Standard for Buildings

- C. Components shall not contain any mercury unless written permission is obtained from Owner.

1.5 WARRANTY

- A. Warrant labor and materials for specified control system free from defects for a period of twelve (12) months after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within twenty-four (24) hours of Owner's warranty service request.
- B. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period. These warranty dates shall be submitted to the Owner.
- C. Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve Contractor-identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization.
- D. Exception: Contractor shall not be required to warrant reused devices except those that have been rebuilt or repaired. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of Engineer's acceptance.

1.6 OWNERSHIP OF PROPRIETARY MATERIAL

- A. Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:
1. Graphics
 2. Record drawings
 3. Database
 4. Application programming code
 5. Documentation

PART 2 - PRODUCTS

2.1 GENERAL DESCRIPTION

- A. The control system shall consist of a high-speed, peer-to-peer network of DDC controllers.
- B. Graphics shall depict each of the building systems controlled. An overall building floor plan and individual rooms shall be accessible using a point and click graphic.
- C. The system shall directly control HVAC equipment as specified on the Drawings. Each zone controller shall provide occupied and unoccupied modes of operation by individual zone. Furnish energy conservation features such as optimal start and stop, night setback, request-based logic, and demand level adjustment of setpoints as specified in the sequence.
- D. The system shall be an extension of the facilities existing system, and allow for integration of occupant card access, fire alarm, and lighting control systems to the current building HVAC equipment.
- E. Provide for future system expansion to include monitoring of occupant card access, fire alarm, and lighting control systems.

2.2 APPROVED CONTROL SYSTEMS

- A. Distech by Woodman Controls

2.3 MATERIALS

- A. Use new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five (5) years after completion of this contract.

2.4 SYSTEM PERFORMANCE

- A. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator web-based interface.
 - 1. A graphic with twenty (20) dynamic points shall display with current data within ten (10) seconds.
 - 2. A graphic with twenty (20) dynamic points shall update with current data within eight (8) seconds and shall automatically refresh every fifteen (15) seconds.
 - 3. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within six (6) seconds.
 - 4. Devices shall react to command of a binary object within two (2) seconds. Devices shall begin reacting to command of an analog object within two (2) seconds.
 - 5. An object that goes into alarm shall be annunciated at the workstation within fifteen (15) seconds.

6. Custom and standard applications shall be capable of running as often as once every five (5) seconds. Select execution times consistent with the mechanical process under control.
7. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per second. Select execution times consistent with the mechanical process under control.
8. System shall report values with minimum end-to-end accuracy listed in Table 230900-1.
9. Control loops shall maintain measured variable at setpoint within tolerances listed in Table 230900-2.

Table 230900-1: Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±1°F
Ducted Air	±1°F
Outside Air Temperature	±2°F
Dew Point Temperature	±3°F
Water Temperature	±1°F
Temperature Difference (Delta-T)	±0.25°F
Relative Humidity	±5% RH
Airflow (terminal)	±10% of full scale (Note 1)
Airflow (measuring stations)	±2% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±0.1 in. w.g.
Air Pressure (space)	±0.01 in. w.g.
Water Flow	±0.2% of full scale (Note 2) ±1.0% of full scale (Note 3)
Water Pressure	±2% of full scale (Note 4)
Electrical (A, V, W, Power Factor)	±1% of reading (Note 5)
Carbon Monoxide (CO)	±3% of reading
Carbon Dioxide (CO ₂)	±50 ppm

Notes:

1. 1 Accuracy applies to 10% - 100% of scale
2. For flanged style water flow meters.
3. For insertion style water flow meters.
4. For both absolute and differential pressure
5. Not including utility-supplied meters

Table 230900-2: Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±0.2 in. w.g. ±0.01 in. w.g.	0 to 6 in. w.g. -0.1 to 0.1 in. w.g.

Airflow	±10% of full scale	
Space Temperature	±2.0°F	
Duct Temperature	±3°F	
Relative Humidity	±5% RH	
Fluid Pressure	±1.5 psi ±1.0 in. w.g.	1 to 150 psi 0 to 50 in. w.g. differential

2.5 COMMUNICATION

- A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a unified control network. A gateway (translator) shall communicate with third-party equipment furnished or installed by others.
- B. Install new wiring and network devices as required to provide a complete and workable control network.
- C. Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.
- D. System shall automatically synchronize controller time clocks daily from an operator-designated controller via the internetwork. If applicable, system shall automatically adjust for daylight saving and standard time.
- E. System shall be expandable to at least twice the required input and output objects with additional controllers, associated devices, and wiring.
- F. System shall support Web services data exchange with any other system that complies with XML (extensible markup language) and SOAP (simple object access protocol) standards specified by the Web Services Interoperability Organization (WS-I) Basic Profile 1.0 or higher. Web services support shall as a minimum be provided at the workstation or web server level and shall enable data to be read from or written to the system.

2.6 OPERATOR INTERFACE

- A. Web-based interface shall reside on high-speed network with building controllers. Each standard browser connected to server shall be able to access all system information.
- B. Operator interface shall allow each authorized operator to execute the following functions as a minimum:
 - 1. System shall require user name and password to log in to operator interface.
 - 2. Operator interface shall be graphically based and shall allow operators to access graphics for equipment and geographic areas using point-and-click navigation.
 - 3. Operators shall be able to:
 - a. View controlled equipment status and to adjust operating parameters such as setpoints, PID gains, on and off controls, and sensor calibration.
 - b. View scheduled operating hours of each schedulable piece of equipment on a weekly or monthly calendar-based graphical schedule display, to select and adjust

- each schedule and time period, and to simultaneously schedule related equipment. System shall clearly show exception schedules and holidays on the schedule display.
 - c. View a list of currently active system alarms, to acknowledge each alarm, and to clear (delete) unneeded alarms.
 - d. View a trend graph of each trended point and to edit graph configuration to display a specific time period or data range. Operator shall be able to create custom trend graphs to display on the same page data from multiple trended points.
 - e. Run preconfigured reports, to view report results, and to customize report configuration to show data of interest.
 - f. View controller status, to reboot each controller, and to download new control software to each controller.
 - 4. Typically, only a few operators are authorized to manage operator access. Authorized operators shall be able to view a list of operators with system access and of functions they can perform while logged in. Operators shall be able to add operators, to delete operators, and to edit operator function authorization. Operator shall be able to authorize each operator function separately.
- C. System Software
- 1. Operating System: Web server or workstation shall have an industry-standard professional-grade operating system. Acceptable systems include Microsoft Windows.
 - 2. System Graphics:
 - a. Operator interface shall be graphically based.
 - b. Each piece of equipment shall include at least one (1) graphic or occupied zone and indicate animations for fans, pumps, dampers, and compressors such that it is intuitive when they are running or when they are stopped.
 - c. Each system graphic shall include a button/tab to a display of the applicable sequence of operation.
 - d. Floorplan layouts showing rooms and temperature are required. Indicate thermal comfort on the floorplan using dynamic colors to represent zone temperature relative to zone setpoint.
 - e. By clicking on the temperature icon, this will direct you to the dedicated graphic with all related information on that piece of equipment i.e. VAV box, AHU, unit heater, etc.
 - f. When the sequence of operation state (adj.), all of these points shall be adjustable by the user from the graphics, i.e. DAT, zone temps, OA enable temps, etc.
 - g. All overridden points shall be highlighted with a unique color to clearly indicate overridden.
- D. System Tools: System shall provide the following functionality to authorized operators as an integral part of the operator interface or as stand-alone software programs. If furnished as part of the interface, the tool shall be available from each workstation or web browser interface. If furnished as a stand-alone program, software shall be installable on standard IBM-compatible PCs with no limit on the number of copies that can be installed under the system license.
- 1. Each web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.
 - 2. Operators shall be able to download memory from the system database to each controller.

3. Context-sensitive online help for each tool shall assist operators in operating and editing the system.
4. System shall require a user name and password to view, edit, add, or delete data.
 - a. Each user name and password combination shall define accessible viewing, editing, adding, and deleting functions in each system application, editor, and object.
 - b. Automatically log out each operator if no keyboard or mouse activity is detected. Operators shall be able to adjust automatic log out delay.
 - c. Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.
5. System shall automatically monitor controller and I/O point operation. System shall annunciate controller failure and I/O point locking (manual overriding to a fixed value).
6. Alarm messages shall use an English language descriptor without acronyms or mnemonics to describe alarm source, location, and nature.
7. The alarm management portion of the user interface shall, at the minimum, provide the following functions:
 - a. Log date and time of alarm occurrence.
 - b. Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm from the workstation or web browser interface.
 - c. Provide an audit trail on hard drive for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.
 - d. At minimum, direct alarms shall be able to log, print, start programs, display messages, send e-mail, send page, send text message, and audibly annunciate. BMS contractor shall coordinate implementation of this feature with the owner as part of the work of this project.
 - e. Any attribute of any object in the system may be designated to report an alarm.
 - f. The system shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions.
 - g. All specified alarms shall be shown on the correct system graphic, turn red and flash.
 - h. Alarm messages shall use an English language descriptor without acronyms or mnemonics to describe alarm source, location, and nature.
8. Operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk.
9. Operator shall be able to view, and to edit if applicable, the status of each system object and property by menu, on graphics, or through custom programs.
10. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.
11. Furnish the following standard system reports:
 - a. System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.

- b. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.
 - c. System shall log the following to a database or text file and shall retain data for an adjustable period:
 - 1) Alarm History.
 - 2) Operator shall be able to select trends to be logged.
 - 3) At a minimum, system shall log operator log in and log out, control parameter changes, schedule changes, and alarm acknowledgment and deletion. System shall date and time stamp logged activity.
- 12. Graphically based tools and documentation shall allow Operator to edit system graphics, to create graphics, and to integrate graphics into the system. Operator shall be able to add analog and binary values, dynamic text, static text, and animation files to a background graphic using a mouse.
- 13. Complete library of standard HVAC equipment graphics shall include equipment such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. Library shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. Library graphic file format shall be compatible with graphics generation tools.
- 14. Operator shall be able to create, edit, debug, and download custom programs. System shall be fully operable while custom programs are edited, compiled, and downloaded.
- E. Portable Operator's Terminal: Provide all necessary software to configure a Windows OS based laptop computer for use as a Portable Operator's Terminal. Operator shall be able to connect configured Terminal to the system network or directly to each controller for programming, setting up, and troubleshooting.

2.7 CONTROLLER SOFTWARE

- A. Building and energy management application software shall reside and operate in system controllers. Applications shall be editable through operator workstation, web browser interface, or engineering workstation.
- B. System shall provide the following schedule options as a minimum:
 - 1. Provide separate schedules for each day of the week. Each schedule shall be able to include up to five (5) occupied periods (five (5) start-stop pairs or ten (10) events).
 - 2. Operator shall be able to designate an exception schedule for each of the next 365 days. After an exception schedule has executed, system shall discard and replace exception schedule with standard schedule for that day of the week.
 - 3. Operator shall be able to define twenty-four (24) special or holiday schedules of varying length on a scheduling calendar that repeats each year.
- C. System shall stagger controlled equipment restart after power outage. Operator shall be able to adjust equipment restart order and time delay between equipment restarts.
- D. Binary output objects shall be protected from short cycling by means of adjustable minimum on-time and off-time settings.
- E. System shall provide an algorithm that can totalize runtime for each binary input and output. Operator shall be able to enable runtime alarm based on exceeded adjustable runtime limit.

F. Remote Communication

1. System shall automatically contact operator workstation or server on receipt of critical alarms. If no network connection is available, system shall use a modem connection.

G. Maintenance Management

1. System shall generate maintenance alarms when equipment exceeds adjustable runtime, equipment starts, or performance limits.

2.8 CONTROLLERS

A. General. Provide Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), Smart Actuators (SA), and Smart Sensors (SS) as required to achieve performance specified.

B. Communication

1. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on drawings.
2. Each piece of equipment specified on Drawings to be controlled or monitored by DDC system shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network.

C. Controller hardware shall be suitable for anticipated ambient conditions.

1. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 32° F to 120° F.
2. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -20° F to 140° F.

D. Provide a local keypad and display for each BC and AAC. Operator shall be able to use keypad to view and edit data. Keypad and display shall require password to prevent unauthorized use. If the manufacturer does not normally provide a keypad and display for each BC and AAC, provide the software and any interface cabling needed to use a laptop computer as a Portable Operator's Terminal for the system.

E. Controllers that perform scheduling shall have a real-time clock.

F. Serviceability

1. Controllers shall have diagnostic LEDs for power, communication, and processor.
2. Wires shall be connected to a field-removable modular terminal strip or to a termination card connected by a ribbon cable.
3. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.

G. Memory

1. Controller memory shall support operating system, database, and programming requirements.
 2. Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.
 3. Each ASC and SA shall use nonvolatile memory and shall retain BIOS and application programming in the event of power loss. System shall automatically download dynamic control parameters following power loss.
- H. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

2.9 INPUT AND OUTPUT INTERFACE

- A. General: Hard-wire input and output points to BCs, AACs, ASCs, or SAs.
- B. Analog inputs shall monitor low-voltage (0-10 Vdc), current (4-20 mA), or resistance (thermistor or RTD) signals. Analog inputs shall be compatible with and field configurable to commonly available sensing devices.
- C. Binary outputs shall send an on-or-off signal for on and off control. Building Controller binary outputs shall have three-position (on-off-auto) override switches and status lights. Outputs shall be selectable for normally open or normally closed operation.
- D. Analog outputs shall send a modulating 0-10 Vdc or 4-20 mA signal as required to properly control output devices. Each Building Controller analog output shall have a two (2)-position (auto-manual) switch, a manually adjustable potentiometer, and status lights. Analog outputs shall not drift more than 0.4% of range annually.
- E. Control three (3)-point floating electronic actuators without feedback with tri-state outputs (two (2) coordinated binary outputs). Tri-State outputs may be used to provide analog output control in zone control and terminal unit control applications such as VAV terminal units, duct-mounted heating coils, and zone dampers.
- F. Universal Inputs and Outputs: Inputs and outputs that can be designated as either binary or analog in software shall conform to the provisions of this section that are appropriate for their designated use.

2.10 AUXILIARY CONTROL DEVICES

- A. Binary Temperature Devices
1. Low-Voltage Space Thermostats: Low-voltage space thermostats shall be 24 V, bimetal-operated, with adjustable or fixed anticipation heater, digital temperature and setpoint display, 55° F - 85° F setpoint range, 2° F maximum differential, and vented ABS plastic cover.
 2. Line-Voltage Space Thermostats: Line-voltage space thermostats shall be bimetal-actuated, open-contact type or bellows-actuated, enclosed, snap-switch type or equivalent solid-state type, with heat anticipator, UL listing for electrical rating, concealed

setpoint adjustment, 55° F - 85° F setpoint range, 2° F maximum differential, and vented ABS plastic cover.

3. Low-Limit Thermostats (Freezestats): Low-limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 20 ft. long. Element shall sense temperature in each 1 ft. section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only. Sensor shall be installed so the entire coil has coverage (1ft. of sensor / 1 sq. ft. of coil and provide multiple units if necessary to meet this requirement). The sensor shall not be installed more than 6" from the edge of the coil. The location of the reset head must be outside the plenum wall and at the highest point of the assembly. The sensing bulb shall be sloped continuously downward from the reset head.

B. Temperature Sensors

1. Type: Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.
2. Duct Sensors: Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 5 ft in length per 10 ft ² of duct cross-section.
3. Immersion Sensors: Provide immersion sensors with a separable stainless steel well. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities.
4. Space Sensors: Space sensors shall have setpoint adjustment, override switch, display, and communication port as shown.
5. Differential Sensors: Provide matched sensors for differential temperature measurement.

C. Humidity Sensors

1. Duct and room sensors shall have a sensing range of 20% - 80%.
2. Duct sensors shall have a sampling chamber.
3. Outdoor air humidity sensors shall have a sensing range of 10% - 95% RH and shall be suitable for ambient conditions of 40° F - 170° F.
4. Humidity sensors shall not drift more than 1% of full scale annually.

D. Flow Switches: Flow-proving switches shall be differential pressure type (air or water service) as shown. Switches shall be UL listed, SPDT snap-acting, and pilot duty rated (125 VA minimum).

1. Differential pressure switches shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

E. Relays

1. Control Relays: Control relays shall be plug-in type, UL listed, and shall have dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.

2. Time Delay Relays: Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable $\pm 100\%$ from setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.

F. Override Timers

1. Unless implemented in control software, override timers shall be spring-wound line voltage, UL Listed, with contact rating and configuration required by application. Provide 0-6 hour calibrated dial unless otherwise specified. Flush mount timer on local control panel face or where shown.

G. Current Transmitters

1. AC current transmitters shall be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4-20 mA two (2)-wire output. Full-scale unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment. Unit accuracy shall be $\pm 1\%$ full-scale at 500 ohm maximum burden.
2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.
3. Unit shall be split-core type for clamp-on installation on existing wiring.

H. Voltage Transmitters

1. AC voltage transmitters shall be self-powered single-loop (two (2)-wire) type, 4-20 mA output with zero and span adjustment.
2. Adjustable full-scale unit ranges shall be 100-130 Vac, 200-250 Vac, 250-330 Vac, and 400-600 Vac. Unit accuracy shall be $\pm 1\%$ full-scale at 500 ohm maximum burden.
3. Transmitters shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized at 600 Vac rating.

I. Power Monitors

1. Power monitors shall be three (3)-phase type and shall have three (3)-phase disconnect and shorting switch assembly, UL listed voltage transformers, and UL listed split-core current transformers.
2. Power monitors shall provide selectable output: Rate pulse for kWh reading or 4-20 mA for kW reading. Power monitors shall operate with five (5) A current inputs and maximum error of $\pm 2\%$ at 1.0 power factor or $\pm 2.5\%$ at 0.5 power factor.

J. Current Switches

1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.

K. Pressure Transducers

1. Transducers shall have linear output signal and field-adjustable zero and span.

2. Continuous operating conditions of positive or negative pressure 50% greater than calibrated span shall not damage transducer sensing elements.
3. Water pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 150 psi. Transducer shall have 4-20 mA output, suitable mounting provisions, and block and bleed valves.
4. Water differential pressure transducer diaphragm shall be stainless steel with minimum proof pressure of 150 psi. Over-range limit (differential pressure) and maximum static pressure shall be 300 psi. Transducer shall have 4-20 mA output, suitable mounting provisions, and five (5)-valve manifold.

L. Differential Pressure Switches:

1. Differential pressure switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum) and shall have scale range and differential suitable for intended application and NEMA 1 enclosure unless otherwise specified.

M. Air Flow Measuring

1. Airflow measuring sensors shall be installed at fan inlet whenever possible and shall be capable of continuously measuring the air handling capacity (air volume) of the respective centrifugal, plug, or vane-axial fan(s).
2. Duct mounted: Thermal dispersion type. Units shall be provided complete with differential pressure transducers, temperature compensation, square root extraction. Unit shall perform all internal calculations to output to the FMS the CFM readings. Provide straight duct before and after device according to the sensor manufacturer's recommendations. Provide access door in ductwork adjacent to sensors.
3. Sensor accuracy shall be +/- 2% of the airflow reading over the entire range of airflow measured.
4. The transmitter shall be capable of displaying the airflow and temperature readings of individual sensors on the LCD display.

N. Gas Detection Equipment

1. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 32 to 104° F and calibrated for 0 to 2%, with continuous or averaged reading, 4-20 mA output, for wall mounting.
2. Carbon Monoxide Detectors: Refer to Specification 230913.
3. Oxygen Depletion Detectors: Refer to Specification 230913. Single detector using long life zirconium oxide sensors rated for a minimum of 8 years runtime; suitable over a temperature range of -40 to 134 F; rated for nitrogen gas compatibility; with dual level alarm relays (4-20 mA output) pre-calibrated to 18.0% and 19.5% O₂; integral audible alarm; 24 VDC powered; and wall mounted.

O. Local Control Panels

1. Indoor control panels shall be fully enclosed NEMA 1 construction with hinged door key-lock latch and removable sub-panels. A common key shall open each control panel and sub-panel.

2. Prewire internal and face-mounted device connections with color-coded stranded conductors tie-wrapped or neatly installed in plastic troughs. Field connection terminals shall be UL listed for 600 V service, individually identified per control and interlock drawings, with adequate clearance for field wiring.
3. Each local panel shall have a control power source power switch (on-off) with overcurrent protection.

2.11 WIRING

A. General Installation and Equipment Requirements

1. The Controls Installer as noted in the scope matrix shall provide and install conduit, hangers, supports, wiring, and cable to meet the requirements noted in applicable sections of the Division 26 specifications. This requirement will maintain a consistent level of quality for all wiring systems in the building.
2. Insulated wire shall use copper conductors and shall be UL listed for 90°C (200°F) minimum service.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Thoroughly examine project plans for control device and equipment locations. Report discrepancies, conflicts, or omissions to Architect or Engineer for resolution before starting rough-in work.
- B. Inspect site to verify that equipment can be installed as shown. Report discrepancies, conflicts, or omissions to Engineer for resolution before starting rough-in work.
- C. Examine drawings and specifications for work of others. Report inadequate headroom or space conditions or other discrepancies to Engineer and obtain written instructions for changes necessary to accommodate temperature controls work with work of others. ATC shall perform at his expense necessary changes in specified work caused by failure or neglect to report discrepancies.

3.2 PROTECTION

- A. Controls Contractor shall protect against and be liable for damage to work and to material caused by Controls Contractor's work or employees.
- B. Controls Contractor shall be responsible for work and equipment until inspected, tested, and accepted. Protect material not immediately installed. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of dust and foreign objects.

3.3 COORDINATION

A. Site

1. Assist in coordinating space conditions to accommodate the work of each trade where work will be installed near or will interfere with work of other trades. If installation without

coordination causes interference with work of other trades, Contractor shall correct conditions without extra charge.

2. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.

B. Test and Balance

1. Provide Test and Balance Contractor a single set of necessary tools to interface to control system for testing and balancing.
2. Train Test and Balance Contractor to use control system interface tools.
3. Test and Balance Contractor shall return tools undamaged and in working condition at completion of testing and balancing.

C. Life Safety

1. Duct smoke detectors required for air handler shutdown are provided under Division 28. Interlock smoke detectors to air handlers for shutdown as specified.
2. Smoke dampers and actuators required for duct smoke isolation are provided under Division 23. Interlock smoke dampers to air handlers as specified. Provide wiring to dampers as required.
3. Fire and smoke dampers and actuators required for fire-rated walls are provided under Division 23. Fire and smoke damper control is provided under Division 28.

D. Coordination with Other Controls: Integrate with and coordinate controls and control devices furnished or installed by others as follows.

1. Communication media and equipment shall be provided as specified.
2. Each supplier of a controls product shall configure, program, start up, and test that product to meet the sequences of operation described on Drawings regardless of where within the contract documents those products are described.
3. Coordinate and resolve incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.
4. Controls Contractor shall be responsible for integration of control products provided by multiple suppliers regardless of where integration is described within the contract documents.
5. The temperature control contractor shall provide all necessary additional sensors to execute all sequences as indicated on the construction documents. Coordinate additional requirements with equipment manufacturer.

3.4 GENERAL WORKMANSHIP

- A.** Install equipment, piping, conduit, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.

- B. Provide sufficient slack and flexible connections to allow for piping and equipment vibration isolation.
- C. Install equipment in readily accessible locations as defined by National Electrical Code (NEC) Chapter 1 Article 100 Part A.
- D. Verify wiring integrity to ensure continuity and freedom from shorts and ground faults.
- E. Equipment, installation, and wiring shall comply with industry specifications and standards and local codes for performance, reliability, and compatibility.
- F. Continually monitor field installation for code compliance and workmanship quality.

3.5 WIRING

- A. Control and interlock wiring and installation shall comply with national and local electrical codes, Division 26, and manufacturer's recommendations. Where the requirements of this section differ from Division 26, this section shall take precedence.
- B. Use color-coded conductors throughout.
- C. Locate control and status relays in designated enclosures only. Do not install control and status relays in packaged equipment control panel enclosures containing Class 1 starters.
- D. Terminate control and interlock wiring related to the work of this section. Maintain at the job site updated (as-built) wiring diagrams that identify terminations.
- E. Low-voltage wiring shall meet NEC Class 2 requirements. Subfuse low-voltage power circuits as required to meet Class 2 current limit.
- F. During installation do not exceed maximum cable pulling, tension, or bend radius specified by the cable manufacturer.
- G. NEC Class 2 (current-limited) wires not in conduit but in concealed and accessible locations such as return air plenums shall be UL listed for the intended application.
- H. Run exposed Class 2 wiring parallel to a surface or perpendicular to it and tie neatly at 10 ft. intervals.
- I. Use structural members to support or anchor plenum cables without conduit. Do not use ductwork, electrical conduits, piping, or ceiling suspension systems to support or anchor cables.
- J. Verify entire network's integrity following cable installation using appropriate tests for each cable.
- K. Install lightning arrestor according to manufacturer's recommendations between cable and ground where a cable enters or exits a building.
- L. Each run of communication wiring shall be a continuous length without splices when that length is commercially available. Runs longer than commercially available lengths shall have as few splices as possible using commercially available lengths.
- M. Label communication wiring to indicate origination and destination.

- N. Ground coaxial cable according to NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."
- O. NEC Class 1 (line voltage) wiring shall be UL listed in approved conduit as specified by NEC and Division 26.
- P. Install wiring in conduit where subject to mechanical damage and at levels below 10ft in mechanical, electrical, or service rooms.
- Q. Install Class 1 and Class 2 wiring in separate conduits. Install communication wiring in separate conduits and enclosures from other wiring.
- R. Boxes and panels containing high-voltage wiring and equipment shall not be used for low-voltage wiring except for the purpose of interfacing the two through relays and transformers.
- S. Do not install wiring in conduit containing pneumatic tubing.
- T. Secure conduits with conduit clamps fastened to structure and spaced according to code requirements. Conduits and pull boxes shall not be hung on or attached to ductwork, electrical conduits, piping, or ceiling suspension systems.
- U. Size conduit and select wire size and type in accordance with manufacturer's recommendations and NEC requirements.
- V. Include one (1) pull string in each conduit 1 in. or larger.
- W. Conceal conduits except within mechanical, electrical, or service rooms. Maintain minimum clearance of 6 in. between conduit and high-temperature equipment such as steam pipes or flues.
- X. Install insulated bushings on conduit ends and enclosure openings. Seal top ends of vertical conduits.
- Y. Flexible metal conduits and liquid-tight flexible metal conduits shall not exceed 3 ft in length and shall be supported at each end. Do not use flexible metal conduit less than 1/2 inch. Use liquid-tight flexible metal conduits in areas exposed to moisture including chiller and boiler rooms.
- Z. Install conduit rigidly, support adequately, ream at both ends, and leave clean and free of obstructions. Join conduit sections with couplings and according to code. Make terminations in boxes with fittings. Make terminations not in boxes with bushings.

3.6 INSTALLATION OF SENSORS

- A. Install sensors according to manufacturer's recommendations.
- B. Mount sensors rigidly and adequately for operating environment.
- C. Install room temperature sensors on concealed junction boxes properly supported by wall framing.
- D. Install all controls devices, sensors, & equipment that is operable or has user adjustment at 42" above finished floor. Dimensions shall be measured from the floor level to the centerline of the device.

- E. Air seal wires attached to sensors in their raceways or in the wall to prevent sensor readings from being affected by air transmitted from other areas.
- F. Use averaging sensors in mixing plenums and hot and cold decks. Install averaging sensors in a serpentine manner vertically across duct. Support each bend with a capillary clip.
- G. Install mixing plenum low-limit sensors in a serpentine manner horizontally across duct. Support each bend with a capillary clip. Provide one (1) ft of sensing element for each one (1) ft² of coil area.
- H. Install pipe-mounted temperature sensors in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.
- I. Install outdoor air temperature sensors on north wall at designated location with sun shield.
- J. Differential Air Static Pressure
 - 1. Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
 - 2. Building Static Pressure. Pipe pressure sensor's low-pressure port to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe high-pressure port to a location behind a thermostat cover.
 - 3. Piping to pressure transducer pressure ports shall contain a capped test port adjacent to transducer.
 - 4. Pressure transducers, except those controlling VAV boxes, shall be located in control panels, not on monitored equipment or on ductwork. Mount transducers in a vibration-free location accessible for service without use of ladders or special equipment.
 - 5. Mount gauge tees adjacent to air and water differential pressure taps. Install shut-off valves before tee for water gauges.
- K. Smoke detectors, freezestats, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Provide contacts that allow DDC software to monitor safety switch status.

3.7 ACTUATORS

- A. General: Mount actuators and adapters according to manufacturer's recommendations.

3.8 WARNING LABELS

- A. Affix permanent warning labels to all equipment that can be automatically started by the control system.
 - 1. Label: Labels shall use white lettering (18-point type or larger) on a red background. Size labels such that they are readily visible when approaching equipment for service.
 - 2. Install labels on equipment in locations of moving parts or electrical hazards such as access doors air handler fan sections, duct mounted heater control panels, pump shaft coupling guards, etc.

3. Warning labels shall read as follows:

<p style="text-align: center;">CAUTION</p> <p>This equipment is operating under automatic control and may start or stop at any time without warning.</p> <p style="text-align: center;">Switch disconnect to "Off" position before servicing.</p>
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- B. Affix permanent warning labels to motor starters and control panels that are connected to multiple power sources utilizing separate disconnects.
1. Labels shall use white lettering (twelve (12)-point type or larger) on a red background.
 2. Warning labels shall read as follows:

<p style="text-align: center;">CAUTION</p> <p>This equipment is fed from more than one (1) power source with separate disconnects.</p> <p style="text-align: center;">Disconnect all power sources before servicing.</p>

3.9 IDENTIFICATION OF HARDWARE AND WIRING

- A. Label wiring and cabling, including that within factory-fabricated panels, with control system address or termination number at each end within two (2) inches of termination.
- B. Permanently label or code each point of field terminal strips to show instrument or item served.
- C. Label control panels per Mechanical Identification specification.
- D. Label each control component with a permanent label. Label plug-in components such that label remains stationary during component replacement.
- E. Label room sensors (not thermostats) related to terminal boxes or valves with nameplates.
- F. Manufacturers' nameplates and UL or CSA labels shall be visible and legible after equipment is installed.
- G. Naming convention shall match Contract Drawings.
- H. Label identifiers shall match record documents.

3.10 CONTROL SYSTEM CHECKOUT AND TESTING

- A. Startup Testing. Complete startup testing to verify operational control system before notifying Owner of system demonstration. Provide Owner with schedule for startup testing. Owner may have representative present during any or all startup testing.
 1. Calibrate and prepare for service each instrument, control, and accessory equipment furnished under the scope of the Contract.
 2. Verify that control wiring is properly connected and free of shorts and ground faults. Verify that terminations are tight.
 3. Enable control systems and verify each input device's calibration. Calibrate each device according to manufacturer's recommendations.

4. Verify that binary output devices such as relays, solenoid valves, two (2)-position actuators and control valves, and magnetic starters, operate properly and that normal positions are correct.
5. Verify that analog output devices such as I/Ps and actuators are functional, that start and span are correct, and that direction and normal positions are correct. Check control valves and automatic dampers to ensure proper action and closure. Make necessary adjustments to valve stem and damper blade travel.
6. Prepare a log documenting startup testing of each input and output device, with technician's initials certifying each device has been tested and calibrated.
7. Verify that system operates according to sequences of operation. Simulate and observe each operational mode by overriding and varying inputs and schedules. Tune PID loops and each control routine that requires tuning.
8. Alarms and Interlocks
 - a. Check each alarm with an appropriate signal at a value that will trip the alarm.
 - b. Trip interlocks using field contacts to check logic and to ensure that actuators fail in the proper direction.
 - c. Test interlock actions by simulating alarm conditions to check initiating value of variable and interlock action.

3.11 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

- A. Demonstration: Prior to acceptance, perform the following performance tests to demonstrate system operation and compliance with specification after and in addition to tests specified in Control System Checkout and Testing. Provide Engineer with log documenting completion of startup tests.
 1. Complete approved checklists and forms for each system as part of system demonstration.
 2. Demonstrate actual field operation of each specified sequence of operation. Provide at least two (2) persons equipped with two (2)-way communication. Demonstrate calibration and response of any input and output points requested by Engineer. Provide and operate test equipment required to prove proper system operation.
 3. Demonstrate compliance with sequences of operation through each operational mode.
 4. Demonstrate complete operation of operator interface.
 5. Demonstrate each of the following.
 - a. Each sample's trend data shall show setpoint, actuator position, and controlled variable values. Engineer will require further tuning of each loop that displays unreasonably under- or over-damped control.
 - b. Building fire alarm system interface.
 - c. Trend data shall indicate setpoints, operating points, valve positions, and other data as specified in the sequence of operation. Each log shall cover three (3) forty-eight (48)-hour periods and shall have a sample frequency not less than ten (10) minutes or as specified.

6. Tests that fail to demonstrate proper system operation shall be repeated after Contractor makes necessary repairs or revisions to hardware or software to successfully complete each test.

B. Acceptance

1. After tests described in this specification are performed to the satisfaction of both Engineer and Owner, Engineer will accept control system as meeting completion requirements. Engineer may exempt tests from completion requirements that cannot be performed due to circumstances beyond Contractor's control. Engineer will provide written statement of each exempted test. Exempted tests shall be performed as part of warranty.

3.12 CLEANING AND REPAIR

- A. On completion of Work, check equipment furnished under this section for paint damage. Repair damaged factory-finished paint to match adjacent areas. Replace deformed cabinets and enclosures with new material and repaint to match adjacent areas.
- B. Clean the outside of all cabinets and sensor enclosures.

3.13 TRAINING

- A. Provide training for a designated staff of Owner's representatives. Training shall be provided via self-paced training, web-based or computer-based training, classroom training, or a combination of training methods.
- B. Training shall enable students to accomplish the following objectives.
 1. Proficiently operate system
 2. Understand control system architecture and configuration
 3. Understand DDC system components
 4. Understand system operation, including DDC system control and optimizing routines (algorithms)
 5. Operate workstation and peripherals
 6. Log on and off system
 7. Access graphics, point reports, and logs
 8. Adjust and change system setpoints, time schedules, and holiday schedules
 9. Recognize common HVAC system malfunctions by observing system graphics, trend graphs, and other system tools
 10. Understand system drawings and Operation and Maintenance manual
 11. Understand job layout and location of control components
 12. Access data from DDC controllers

- 13. Operate portable operator's terminals
- 14. Configure and run reports
- C. Divide presentation of objectives into three (3) sessions. Participants will attend one (1) or more of sessions, depending on knowledge level required.
- D. Provide one (1) copy of training manual for each student.
- E. Provide complete training for each shift of staff.
- F. Include a minimum of eight (8) total hours of on-site training in bid.
- G. Instructors shall be factory-trained and experienced in presenting this material.
- H. Perform classroom training using a network of working controllers, representative of installed hardware.

END OF SECTION

SECTION 23 1126 – NATURAL GAS PIPING

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the following Natural gas Piping System indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Equipment Included in This Section
 - 1. Piping
 - 2. Regulators
 - 3. Unions
 - 4. Valves

1.2 REFERENCES

- A. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. Adopted version of the International Fuel Gas Code.
 - 2. Adopted version of NFPA 54, National Fuel Gas Code.
 - 3. ASME as it pertains to the welding of piping.
 - 4. State Boiler Code

1.3 SUBMITTALS

- A. Product Data
 - 1. Catalog sheets and specifications indicating manufacturer name, type, applicable reference standard, schedule, or class for specified pipe and fittings.
 - 2. Material Schedule: Itemize pipe and fitting materials for each specified application in Pipe and Fittings Schedule in Part 3 of this Section. Where optional materials are specified indicate option selected.
- B. Submit piping layout drawings as per Section 230500.

1.4 QUALITY ASSURANCE

- A. All materials, equipment and Work shall meet or exceed all applicable federal, state and local requirements and conform to codes and ordinances of authorities having jurisdiction.

- B. Valves: Manufacturer's name, size, standards compliance and pressure rating clearly marked on outside of valve body.
- C. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.
- E. Installer Qualifications: Company specializing in performing the Work of this Section with minimum three (3) years documented experience. All installation shall be supervised by a licensed Master Plumber. All testing shall be performed by a licensed Journeyman or Master Plumber. Welders shall be certified in accordance with ASME.

1.5 EXTRA MATERIALS

- A. Provide one (1) plug valve wrench for every ten (10) plug valves sized 2 inches and smaller, minimum of one (1). Provide each plug valve sized 2-1/2 inches and larger with a wrench incorporating a setscrew.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. Natural gas pressures shall not exceed two (2) pounds per square inch gauge on customer side of the meter.
- C. Pipe joint compound shall be lead-free, non-toxic, non-hardening, insoluble in the presence of natural gas and compliant with ANSI/NSF 61 and Federal Specification TT-S-1732. Temperature service range of -15° F to +400° F.

2.2 PIPING

- A. Steel Piping
 - 1. Schedule 40 black steel, ASTM A53, Grade A or B, seamless or electric resistance welded.
 - a. Malleable Iron, Steam Pattern Threaded Fittings
 - 1) 150 lb Class: ASME B16.3
 - b. Schedule 40 Carbon Steel Fittings
 - 1) ASME B16.9
- B. Corrugated Stainless Steel Tubing (CSST) & Fittings
 - 1. Tubing shall be made from 300 series stainless steel strip conforming to ASTM A240 & shall be suitable for operation with fuel gases.
 - 2. Tubing shall be rated for a minimum of 25 PSI operating pressure.

3. Tubing come with a factory installed, integral polyethylene sleeve. The polyethylene sleeve shall have internal vent channels lengthwise to direct any leakage along the pipe to the end fittings. The construction of the pre-sleeved system shall provide the code required encasement & venting capabilities of the system.
4. All fittings shall be non-gasketed, CSA International listed for installation in concealed locations, & constructed of yellow brass with a stainless steel insert.
5. All fittings shall be provided with a plastic containment coupling & a ¼" NPT vent port to provide venting as required.
6. The underground piping system shall be listed by the International Code Council (ICC) or the International Association of Plumbing & Mechanical Officials (IAPMO) for underground or underground beneath building applications
7. Vent pipe material shall be schedule 40 black steel. All vent piping shall be routed & terminated per the International Fuel Gas Code & NFPA 54 requirements.
8. Approved manufacturers: TracPipe PS-II or prior approved equal.

2.3 EXCEPTIONS

- A. Gas piping is prohibited from being installed in solid partitions or walls unless a chase or casing (pipe sleeve) is provided.
- B. Threaded fittings shall not be used for pipe sizes 4 inches and larger.

2.4 VALVES

- A. Acceptable Manufacturers:
 1. A.Y. McDonald
 2. Nibco
 3. Milwaukee
 4. Nordstrom
 5. Mueller.
- B. All valves shall be designed, manufactured and approved for natural gas service.
- C. Line Shut-off Valves sizes 2" and smaller:
 1. Iron body lubricated plug valve conforming to ASME B16.33, U.L. Listed, and A.G.A. Approved for natural gas service with threaded ends, wrench operation, rated for 200 WOG service pressure and -20 to 200° F.
 2. Brass body, full port ball valve conforming to ASME B16.33, U.L. Listed. Blowout-proof stem and PTFE seats. Approved for natural gas service up to and including 5 psig with threaded ends, rated for 125 psig working pressure and -4 to 200°F working temperature.

D. Line Shut-off Valves sizes 2 1/2" and larger:

1. Iron body lubricated plug valve conforming to ASME B16.44, U.L. Listed, and A.G.A. Approved for natural gas service with flanged ends, wrench operation, rated for 200 WOG service pressure and -20 to 200° F.
2. Brass body, full port ball valve (2-1/2" – 4") conforming to ASME B16.44 and U.L. Listed. Blowout-proof stem and PTFE seats. Approved for natural gas service up to and including 5 psig with threaded ends, rated for 250 psig working pressure and -4 to 200°F working temperature.

E. Appliance/Equipment Shut-off Valves at local connections sizes two (2) inches and smaller shall be bronze body, full port ball or butterfly type, U.L. Listed, and A.G.A. Approved for natural gas service with threaded ends, quarter turn lever handle operation, rated for 175 W.O.G. service pressure and 30 to 275° F.

F. Manual Emergency Shut-off Valves 2" and smaller shall be bronze body, full port ball or butterfly type, U.L. Listed, and A.G.A. Approved for natural gas service with threaded ends, quarter turn lever handle operation, rated for 175 W.O.G. service pressure and 30 to 275° F.

G. Automatic Emergency Shut-off Valves shall be U.L. Listed for natural gas service, two (2)-way electrically tripped solenoid type; fail safe closed; manual reset; Type 1 solenoid enclosure; NBR seals and disc; stainless steel core tube and springs; copper coil.

2.5 PRESSURE REGULATORS

A. Acceptable Manufacturers:

1. Fisher
2. Maxitrol
3. Rockwell
4. Schlumberger.

B. All pressure regulators shall be designed, manufactured and approved for natural gas service.

C. Pressure regulators for individual service lines shall be capable of reducing distribution line pressure to pressures required for equipment. Pressure relief shall be set at a lower pressure than would cause unsafe operation of any connected unit. Regulator shall have a single port with orifice diameter no greater than that recommended by manufacturer for the maximum gas pressure at the regulator inlet. Regulator vent valve shall be of resilient materials designed to withstand flow conditions when pressed against valve port. Regulator shall be capable of limiting build-up of pressure under no-flow conditions to 50 percent or less of the discharge pressure maintained under flow conditions. Commercial grade diaphragm type with internal relief valve, vent valve, cast iron body, Buna-N diaphragm.

D. Install pressure gauge adjacent to and downstream of each line pressure regulator.

2.6 UNIONS

A. Unions in 2" and smaller in ferrous lines shall be Class 300 AAR malleable iron unions with iron to brass seats, 2-1/2" and larger shall be ground flange unions. Companion flanges on lines at

various items of equipment, machines and pieces of apparatus may serve as unions to permit disconnection of piping.

- B. Unions connecting ferrous pipe to copper or brass pipe shall be Epco dielectric type.
- C. Above grade flexible stainless steel appliance/equipment connectors shall conform with AGA under the ANSI Z21.69 Standard. Hose shall be braided stainless steel with a polyolefin heat-shrink tubing with high flame-retardant qualities. Hose shall be equipped with malleable iron unions and spring loaded brass quick-link couplings. An easily accessible manual shut-off valve shall be installed ahead of all hose connections. Specify T&S Brass "Safe-T-Link" or approved equal.

2.7 FLANGES

- A. All 150 lb. and 300 lb. ANSI flanges shall be domestically manufactured, weld neck forged carbon steel, conforming to ANSI B16.5 and ASTM A-181 Grade I or II or A-105-71. Slip on flanges shall not be used.
- B. Each fitting shall be stamped as specified by ANSI B16.9 and, in addition, shall have the laboratory control number stenciled on each fitting for ready reference as to physical properties and chemical composition of the material. Complete test reports may be required for any fitting selected at random.
- C. Flanges which have been machined, remarked, painted or otherwise produced domestically from imported forges will not be acceptable. Flanges shall have the manufacturer's trademark permanently identified in accordance with MSS SP-25.
- D. Bolts used shall be carbon steel bolts with semi-finished hexagon nuts of American Standard Heavy dimensions. Threaded rods will not be an acceptable alternate for flange bolts. Bolts shall have a tensile strength of 60,000 psi and an elastic limit of 30,000 psi.
- E. Flat-faced flanges shall be required to match flanges on pumps, check valves, strainers, etc. Only one (1) manufacturer of weld flanges will be approved for each project.
- F. All flanges shall be gasketed. Contractor shall place gasket between flanges of flanged joints. Gaskets shall fit within the bolt circle on raised face flanges and shall be full face on flat face flanges. Gaskets shall be cut from 1/16" thick, non metallic, non asbestos gasket material suitable for operating temperatures from -150° F to +75° F.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE AND HANDLING

- A. Accept piping, fittings, and accessories on Site in shipping containers with labeling in place, inspect for damage and store with a minimum of handling. Store plastic piping under cover out of direct sunlight. Do not store materials directly on the ground.
- B. Provide temporary protective coating on all cast iron and steel devices.
- 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.

3.2 PREPARATION

- A. Ream pipe ends and remove cutting burrs. Bevel plain end ferrous pipe.
- B. Remove cutting oil, scale and dirt, on inside and outside of piping, before assembly.

3.3 PAINTING

- A. Prepare all piping as needed to allow for proper coverage and adherence.
- B. Piping to be painted includes the following:
 - 1. Exterior to building: Color selected by Architect.
 - 2. Interior to building: Yellow

3.4 EQUIPMENT CONNECTIONS

- A. Provide specified connections, shutoff valves, regulators and unions at each and every appliance and piece of equipment requiring natural gas, including equipment furnished under other Divisions of these Specifications and/or by the Owner.
- B. Provide and install union type connections at all equipment to permit removal of service piping.
- C. Gas service connections shall have a diameter at least one (1) pipe size larger than that of the inlet connection to the equipment as provided by the manufacturer and be of adequate size to provide the total input demand of the connected equipment.
- D. Provide listed and labeled appliance connectors complying with ANSI Z21.69 and listed for use with food service equipment having casters, or that is otherwise subject to movement for cleaning, and other large movable equipment. Connectors shall have listed and labeled quick-disconnect devices and shall have retaining cables attached to structures and equipment. Connectors shall not be concealed within or extended through wall, floor or partition and shall be located entirely in the same room as the connected equipment. Provide an accessible shut-off valve not less than the nominal size of the equipment connector, immediately ahead of the connector.
- E. Rigid metallic pipe and fittings shall be used at service connections to all permanently stationary equipment.

3.5 INSTALLATION - GENERAL

- A. All gas piping installed in return air plenums shall be welded.
- B. Valves shall not be installed in concealed locations and return air plenums.
- C. Line shutoff valves installed exterior to the building shall be plug valves. Line shutoff valves installed interior to the building shall be full-port ball valves.

- D. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- E. All installation shall be in accordance with manufacturer's published recommendations.
- F. Provide support for and connections to natural gas service meter in accordance with requirements of the utility company.
- G. All installation shall be in accordance with manufacturer's published recommendations.
- H. All above ground gas piping shall be electrically continuous and bonded to electrical system ground conductor in accordance with NFPA 70.
- I. Provide and install unions at proper points to permit dismantling or removal of pipe. No unions will be required in welded lines except at equipment connections.
- J. Provide dielectric isolation device where copper lines connect to ferrous lines or equipment, such as dielectric union, coupling or dielectric flange fitting.
- K. Valves, regulators, flanges, unions and similar appurtenances shall be accessible for operation and servicing and shall not be located above ceilings in accessible locations or within partitions.
- L. Route piping in orderly manner and maintain gradient. Install piping to conserve building space. Group piping whenever practical at common elevations.
- M. Install piping to allow for expansion and Contraction without stressing pipe, joints, or connected equipment.
- N. Make service connections at the top of the main, whenever the depth of the main is sufficient to allow top connections. When service connections cannot be made at the top of the main, they shall be made on the side of the main no lower than the horizontal midpoint of the gas main.
- O. Cross type fittings shall not be installed in any gas line. Bushings shall not be used in conjunction with any gas piping.
- P. Slope piping and arrange to drain at low points. Install drip/sediment traps at points where condensate and debris may collect. Locate drip/sediment traps where readily accessible for cleaning and emptying. Do not install where condensate would be subject to freezing. Construct drip/sediment traps using tee fitting with capped nipple connected to bottom outlet. Use minimum-length nipple of three (3) pipe diameters, but not less than 4 inches long, and same size as connected pipe. Cap shall be screwed pattern, black, standard weight, malleable iron. Install with adequate space for removal of cap.
- Q. Install valves for shut off and to isolate equipment, parts of systems, or vertical risers. All valves shall be located such that servicing and operation is possible. All flanged valves shown in horizontal lines with the valve stem shall be positioned so that the valve stem is inclined one bolt hole above the horizontal position. Screw pattern valves placed in horizontal lines shall be installed with their valve stems inclined at an angle of a minimum of 30 degrees above the horizontal position. All valves must be true and straight at the time the system is tested and inspected for final acceptance. Valves shall be installed as nearly as possible to the locations indicated in the Contract Drawings. Any change in valve location must be so indicated on the Record Drawings.
- R. Install line shut-off valve at each branch connection to riser. Branch line shut-off valves shall be automatic type where indicated on Drawings.

- S. Provide adequate clearance for access to and operation of all valves.
- T. Install valves with stems upright or horizontal, not inverted unless required otherwise by the valve manufacturer.
- U. Pipe vents from gas pressure reducing valves and pipe casing sleeves to the exterior of the building and terminated with outlet turned down and capped with corrosion resistant insect screen. Vent terminations shall be at least seven feet above grade or pedestrian traffic and a minimum five (5) feet above or ten (10) feet horizontally from all air intakes or building openings.
- V. Above ground horizontal natural gas and encasement piping shall be supported at intervals of no greater than 6 foot for 1/2" piping, 8 foot for 3/4" and 1" piping and 10 foot for 1-1/4" and larger piping. Vertical piping shall be supported at each floor level and at intervals as specified for horizontal piping.
- W. Extension bars shall not be used for supporting gas or encasement piping. Gas or encasement piping shall not be used to support any other piping or component.

3.6 INSTALLATION - WELDED PIPING

- A. Welding of pipe in normally occupied buildings is prohibited. Off-Site welding is acceptable. Should welding be required in a normally occupied building for connecting to an existing welded system, obtain written approval from the General Contractor and comply with Owner's fire and life safety requirements.
- B. Piping and fittings shall be welded and fabricated in accordance with ASME/ANSI.
- C. Ensure complete penetration of deposited metal with base metal. Provide filler metal suitable for use with base metal. Maintain inside of fittings free from globules of weld metal. All welded pipe joints shall be made by the fusion welding process, employing a metallic arc or gas welding process. All pipes shall have the ends beveled 37 1/2 degrees and all joints shall be aligned true before welding. Except as specified otherwise, all changes in direction, intersection of lines, reduction in pipe size and the like shall be made with factory-fabricated welding fittings. Mitering of pipe to form elbows, notching of straight runs to form tees, or any similar construction will not be permitted.
- D. Align piping and equipment so that no part is offset more than 1/16". Set all fittings and joints square and true and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.
- E. Contractor shall not permit any weld to project within the pipe so as to restrict it. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welded during welding operation.
- F. In no cases shall Schedule 40 pipe be welded with less than three (3) passes including one (1) stringer/root, one (1) filler and one (1) lacer. Schedule 80 pipe shall be welded with not less than four (4) passes including one (1) stringer/root, two (2) filler and one (1) lacer. In all cases, however, the weld must be filled before the cap weld is added.

3.7 INSTALLATION – CORRUGATED STAINLESS STEEL TUBING

- A. Install and support all corrugated stainless steel tubing in accordance with manufacturer's recommendations.

- B. All piping system vents shall be routed to the building exterior per code & local AHJ requirements.

3.8 WELD TESTING

- A. All welds are subject to inspection, visual and/or x-ray, for compliance with Specifications. At the Owner's option, the Owner will provide employees or employ a testing laboratory for the purposes of performing said inspections and/or x-ray testing. Initial visual and x-ray inspections will be provided by the Owner. The Contractor shall be responsible for all labor, material and travel expenses involved in the re-inspection and retesting of any welds found to be unacceptable. In addition, the Contractor shall be responsible for the costs involved in any and all additional testing required or recommended by ASME/ANSI Standards B31.1 and B31.3 due to the discovery of poor, unacceptable or rejected welds.
- B. Welds lacking penetration, containing excessive porosity or cracks, or are found to be unacceptable for any reason, must be removed and replaced with an original quality weld as specified herein. All qualifying tests, welding and stress relieving procedures shall, moreover, be in accord with Standard Qualification for Welding Procedures, Welders and Welding Operators, Appendix A, Section 6 of the Code, current edition.

3.9 TESTING

- A. All natural gas systems shall be inspected, tested, purged and placed into operation in accordance with NFPA 54 and as required herein.
- B. All natural gas piping systems shall be very carefully inspected, tested, purged and placed into operation by a Licensed Plumber.
- C. All necessary apparatus for conducting tests shall be furnished by the Contractor and comply with the requirements of NFPA 54.
- D. All new rough-in distribution piping and affected portions of existing systems connected to, shall be subjected to a pneumatic test pressure utilizing clean, dry air and must be demonstrated to be absolutely tight when subjected to the pressures and time durations listed herein. All equipment and components designed for operating pressures of less than the test pressure shall not be connected to the piping system during test.
- E. Systems on which the normal operating pressure is less than 0.5 pounds per square inch gauge (psig), the test pressure shall be 5.0 psig and the time interval shall be thirty (30) minutes.
- F. Systems on which the normal operating pressure is between 0.5 psig and 5.0 psig, the test pressure shall be 1.5 times the normal operating pressure or 5.0 psig, whichever is greater, and the time interval shall be thirty (30) minutes.
- G. Systems on which the normal operating pressure is 5.0 psig or greater, the test pressure shall be 1.5 times the normal operating pressure, and the time interval shall be one (1) hour.
- H. After testing is complete, the entire gas system shall be purged with dry nitrogen to eliminate all air, debris and moisture from the piping before natural gas is introduced into the system.
- I. After successful results of pressure test and purging have been completed, a leakage test shall be performed in accordance with NFPA 54 Appendix D.

- J. Connect, inspect and purge gas utilization equipment, lab hook-ups, outlets, etc., and place into operation only after successful results of pressure test, leakage test and purging have been completed and accepted.
- K. In all instances in which leaks are then found, they shall be eliminated. Testing operations shall be repeated until gas-piping systems are absolutely tight at the pneumatic test pressures indicated above.
- L. Pressure test gas piping sleeve system with clean, dry compressed air at 15 psig by temporarily sealing all openings between gas carrier pipe and sleeve and vent openings. Sleeve systems must be demonstrated to be absolutely tight when subjected to this pressure for a period of four (4) hours.

END OF SECTION

SECTION 23 3113 – METAL DUCTWORK

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all work required to provide and install the Ductwork Insulation indicated by the Contract Documents with supplementary items necessary for proper installation.

1.2 REFERENCES

- A. National Fire Protection Association (NFPA)
- B. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
- C. Definition
 - 1. Low Pressure
 - a. 2 inch W.G. Pressure Class: Ductwork systems up to 2 inch w.g. positive or negative static pressure with velocities less than or equal to 1500 fpm.
 - 2. Medium Pressure
 - a. 3 inch W.G. Pressure Class: Ductwork systems over 2 inch w.g. and up to 3 inch W.G. positive or negative static pressure with velocities less than or equal to 2500 fpm.
 - b. 4 inch W.G. Pressure Class: Ductwork systems over 3 inch w.g. and up to 4 inch w.g. positive or negative static pressure with velocities less than or equal to 2500 fpm.
 - c. 6 inch W.G. Pressure Class: Ductwork systems over 4 inch w.g. and up to 6 inch w.g. positive or negative static pressure with velocities less than or equal to 2500 fpm.
 - 3. High Pressure
 - a. 10 inch W.G. Pressure Class: Ductwork systems over 6 inch w.g. and up to 10 inch w.g. positive or negative static pressure with velocities greater than 2500 fpm.

1.3 SUBMITTALS

- A. Shop Drawings
 - 1. Submit CAD drawn duct layout drawings for all project ductwork. Submit detailed elevations and sections where required to convey complete scope of work. Shop drawings shall be based on other trades contract drawings and field dimensions. Submit drawings on full size paper at 1/4" = 1'-0" scale.
- B. Coordinate shop drawings with related contractors prior to submission.
- C. Product Data: Material, gauge, type of joints, sealing materials, and reinforcing for each duct size range, including sketches or SMACNA plate numbers for joints, method of fabrication and reinforcing. Include ACGIH figure numbers for hoods if applicable.

1.4 QUALITY ASSURANCE

- A. SMACNA: Gauges of materials, fabrication, reinforcement, sealing requirements, installation, and method of supporting ductwork shall be in accordance with the following SMACNA manuals, unless otherwise shown or specified:
 - 1. HVAC Duct Construction Standards
- B. Unless otherwise shown or specified, follow the Hood Design Data, and Construction Guidelines for Local Exhaust Systems from the ACGIH Industrial Ventilation Manual.
- C. Conform to the applicable requirements of NFPA 90A, 90B, 91, 96, and 101.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Sheet Metal
 - 1. Aluminum: ASTM B-209, Alloy 3003, Temper H-14.
 - 2. Carbon Steel: 16 gauge black iron
 - 3. Galvanized Steel: ASTM A653, ASTM A924, Class LFQ (lock forming quality), coating designation G-60.
 - 4. Stainless Steel: AISI Types 302, 304 and 316, as specified.
- B. Duct Hangers
 - 1. Strap Hangers: Same material as ducts, except that hangers for stainless steel ducts in unfinished spaces may be galvanized steel.
 - 2. Rod Type Hangers: Mild low carbon steel, unless otherwise specified; fully threaded or threaded each end, with 2 removable nuts each end for positioning and locking rod in place. Unless stainless steel, galvanized or cadmium plated; shop coat with metal primer.
- C. Miscellaneous Fasteners and Upper Hanger Attachments
 - 1. Sheet Metal Screws, Machine Bolts and Nuts: Same material as duct, unless otherwise specified.
 - 2. Concrete Inserts: Steel or malleable iron, galvanized; continuously slotted or individual inserts conforming with MSS SP-58, Types 18 & 19, Class A-B.
 - 3. C Clamps: Fee & Mason Co.'s 255L with locking nut, and 255S with retaining strap.
 - 4. Metal Deck Ceiling Bolts: B-Line Systems, Inc.'s Fig. B3019.
 - 5. Welding Studs: Erico Fastening Systems, capacitor discharge, low carbon steel, copper flashed.

6. Structural (carbon) Steel Shapes and Steel Plates: ASTM A36, shop primed.
7. Stainless Steel Shapes and Plates: ASTM A276 and ASTM A666.
8. Machine Bolt Expansion Anchors
 - a. Non-caulking single unit type: FS FF-S-325, Group II, Type 2, Class 2, Style 1.
 - b. Non-caulking double unit type: FS FF-S-325, Group II, Type 2, Class 2, Style 2.
 - c. Self-drilling type: FS FF-S-325, Group III, Types 1 and 2.

2.2 FABRICATION – GENERAL

- A. Refer to the ductwork application schedule on the drawings for the types and material usage for the various ductwork types required.

2.3 FABRICATION OF STAINLESS STEEL DUCTS

- A. Use minimum No. 18 gauge for exhaust ducts connected to cooking equipment hoods. Use minimum No. 20 gauge for exhaust ducts connected to other hoods. Use minimum 26 gauge for dryer exhaust ducts.
- B. Use stainless steel reinforcing members for ducts in finished spaces and galvanized steel in unfinished spaces.
- C. Longitudinal Seams for Dishwashing, and Other Scullery Equipment Exhaust Ducts: Form double corner seams, or Pittsburgh lock seams.
 1. Fabricate elbows and transitions with Pittsburgh lock seams.
 2. Fabricate double compounded elbows and other complex fittings with double corner seams.
 3. Locate seams in horizontal ducts at top corners of ducts, unless otherwise approved in writing.
 4. Locate seams in vertical ducts at rear corners of ducts.
- D. All exposed stainless steel ductwork shall have a #3 finish.

2.4 VIBRATION ISOLATION FOR DUCTWORK

- A. Type: Combination rubber and spring type designed for insertion in a split hanger rod for isolating ductwork from the overhead construction.
 1. Approved isolators: Amber Booth Type BSSR, Korfund Type VX, Mason Industries, Type DNHS, Vibration Eliminator Co. Type SNRC and Vibration Mountings and Controls Type RSH.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

- A. Install ductwork to allow maximum headroom. Properly seam, brace, stiffen, support, and

render ducts mechanically airtight. Adjust ducts to suit job conditions. Dimensions may be changed as approved if cross sectional area is maintained.

- B. Pitch horizontal ducts connected to hoods downward toward hood not less than 1 inch in 10 feet.
- C. Provide necessary transformation pieces, and flexible fabric connections for ductwork connected to air handling equipment or air inlet and outlet devices. Flexible fabric connections installed at equipment exterior to the building shall be rated for UV exposure and suitable for exterior use per ASTM G155 leasing requirements. Metal for these connections shall be aluminum or stainless steel, galvanized connections shall not be allowed.

3.2 SEALING SEAMS, JOINTS, AND PENETRATIONS

- A. Seal ductwork in accordance with the SMACNA Manual except for the following:
 - 1. Ductwork Specified to be Insulated: Conform with Seal Class A for all pressure classes.
 - 2. Cooking Equipment Exhaust Ductwork: Conform with NFPA 96.
 - 3. Horizontal Ductwork for Dishwashing, and Other Scullery Equipment Exhausts
 - a. Continuously solder transverse joints vaportite along bottom, and up both sides two (2) inches minimum.
 - b. Continuously solder longitudinal seams vaportite if seams are approved to be located at bottom of duct.
 - 4. Exhaust ductwork joints shall not use sheetmetal screws or other fasteners that protrude into the ductwork to catch lint and debris. Ducts shall insert and adjoin to the next duct or fitting in the direction of airflow. Seal all joints and seams vapor tight with ductwork foil tape.

3.3 HANGERS FOR DUCTS, UNDER 2 INCHES W.G.

- A. Install hangers for ducts as specified in the SMACNA Manual, with the following exceptions:
 - 1. Rectangular ducts up to 42 inches wide, not having welded or soldered seams, and supported from overhead construction; extend strap hangers down over each side of the duct and turn under bottom of duct a minimum of two (2) inches. Secure hanger to duct with three (3) full thread sheet metal screws, one (1) in the bottom and two (2) in the side of the duct.
 - 2. Rectangular ducts 43 inches wide and over, and all sizes of duct with welded or soldered seams, and supported from overhead construction; use trapeze hangers.
 - 3. Prime coat plain steel rods threaded at the site immediately after installation with metal primer.
 - 4. Dryer exhaust ductwork shall be supported at 48 inch intervals.

3.4 HANGERS FOR DUCTS, 2 INCHES W.G. AND OVER

- A. Install hangers for ducts as specified in the SMACNA Manual, with the following exceptions:

1. Support rectangular ducts with welded seams, regardless of size, by means of trapeze hangers, framed all four (4) sides. Provide minimum 1 x 1 x 1/8 inch angle iron framing for duct having a maximum side dimension up to and including 36 inches in size. Install framing snug to all four (4) sides of duct.

3.5 UPPER HANGER ATTACHMENTS

A. General

1. Secure upper hanger attachments to structural steel or steel bar joists wherever possible.
2. Do not use drive-on beam clamps, flat bars or bent rods, as upper hanger attachments.
3. Do not attach hangers to steel decks which are not to receive concrete fill.
4. Do not attach hangers to precast concrete planks less than 2-3/4 inches thick.
5. Avoid damage to reinforcing members in concrete construction.
6. Metallic fasteners installed with electrically operated or powder driven tools may be used as upper hanger attachments, in accordance with the SMACNA Manual, with the following exceptions:
 - a. Do not use powder driven drive pins or expansion nails.
 - b. Do not attach powder driven or welded studs to structural steel less than 3/16 inch thick.
 - c. Do not support a load, in excess of 250 lbs from any single welded or powder driven stud.
 - d. Do not use powder driven fasteners in precast concrete.

B. Attachment to Steel Frame Construction: Provide intermediate structural steel members where required by ductwork support spacing. Select steel members for use as intermediate supports based on a minimum safety factor of five (5).

1. Secure upper hanger attachments to steel bar joists at panel points of joists.
2. Do not drill holes in main structural steel members.

C. Attachment to Concrete Filled Steel Decks

1. New Construction: Install metal deck ceiling bolts.
2. Existing Construction: Install welding studs (except at roof decks).
3. Do not attach hangers to decks less than 2-1/2 inches thick.

D. Attachment to Hollow Block or Hollow Tile Filled Concrete Decks

1. New Construction: Omit block or tile and pour solid concrete with cast-in-place inserts.
2. Existing Construction: Break out block or tile to access and install machine bolt anchors at highest practical point on side of web.

E. Attachment to Wood Construction

1. Secure strap hangers to the sides of wood beams with one (1) No. 18 x 1-1/2 inch long

(minimum) wood screws or two (2) No. 16 x 1-1/2 inch long (minimum) drive screws. Do not hammer in wood screws.

2. Secure rod hangers to angle iron clip angles, bolted or screwed to the sides of the wood beams with 3/8 inch bolts or 3/8 inch lag screws. Install hanger rods with a threaded end through a hole in the angle, secured with a double nut, one (1) above and one (1) below the angle. Do not use lag screws in wood beams, having a nominal face width under 2 inches. Install bolts or lag screws in the side of beams at mid-point or above.
3. Pre-drill holes for lag screws 1/8 inch in diameter less than the root diameter of the lag screw thread.
4. Where wood trusses are approved to support ductwork, hangers may be attached only to the bottom chord. Method of attachment must be specifically approved.
5. Do not secure hanger attachments to nailing strips resting on top of steel beams.

3.6 DUCT RISER SUPPORTS, UNDER 2 INCHES W.G.

- A. Support vertical round ducts by means of double-ended split steel pipe riser clamps bearing on floor slabs or adjacent structural members, at every other floor through which the riser passes.
- B. Unless otherwise specified or shown on the drawings, support vertical rectangular ducts by means of two steel angles, secured to duct and resting on floor slab or adjacent structural steel member, at every other floor through which the duct passes. Size supports as follows:

MAX. SIDE DIMENSION (inches)	SUPPORT ANGLE (inches)	SECURE TO DUCT WITH	MIN BEARING AT EACH END (inches)
36	1 x 1 x 1/8	Screws	2
48	1-1/2 x 1-1/2 x 1/8	Bolts	3
60	2 x 2 x 1/8	Bolts	3
61 - up	2-1/2 x 2-1/2 x 3/16	Bolts	4

3.7 DUCT RISER SUPPORTS, 2 INCHES W.G. AND OVER

- A. Support vertical round ducts by means of double-ended split steel pipe riser clamps welded to the ducts and bearing on floor slabs or adjacent structural members, at every other floor through which the riser passes.
- B. Support vertical rectangular ducts by means of two steel angles or channels, anchor bolted to floor slab or adjacent structural member at every other floor through which the riser passes. Secure steel angles or channels to a transverse joint by means of 3/8 inch bolts, or by welding. Size supports as follows:

MAXIMUM SIDE DIMENSION (inches)	SUPPORT ANGLE (inches)	SUPPORT CHANNEL (inches)	MINIMUM BEARING AT EACH END (inches)
36	1 x 1 x 1/8	1 x 1/2 x 1/8	2
48	1-1/2 x 1-1/2 x 1/8	1-1/2 x 3/4 x 1/8	3
60	2 x 2 x 1/8	2 x 1 x 1/8	3
61 - up	2-1/2 x 2-1/2 x 3/16	2 x 1 x 3/16	4

3.8 VIBRATION ISOLATION FOR DUCTWORK

- A. Install vibration isolation in accordance with the manufacturer's printed installation instructions, unless otherwise specified.
- B. Install in locations shown or scheduled on the Drawings.
- C. High Velocity Ductwork Installed within Mechanical Equipment, Machine and Penthouse Mechanical Equipment Rooms: Provide combination rubber and spring type isolators, designed for insertion in a split hanger rod for overhead supported ductwork and double rubber-in-shear isolators for floor supported ductwork. Provide isolators designed for a static deflection of 1/2 inch.

3.9 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state, and local requirements, referenced standards, and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.
- C. Cleanliness
 - 1. Before installing ductwork, wipe ductwork to a visibly clean condition.
 - 2. During construction, provide temporary closures of metal or taped polyethylene on open ductwork and duct taps to prevent construction dust or contaminants from entering ductwork system. Seal ends of ductwork prior to installation to keep ductwork interior clean. Remove closures only for installation of the next duct section.
 - 3. During duration of construction, maintain the integrity of all temporary closures until air systems are activated.
 - 4. Provide openings in ductwork where required to accommodate thermometers, controllers, and other devices. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring. Sleeve of pitot tube opening shall be no more than one inch long. Opening shall be one inch wide to accept pitot tube.
 - 5. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
 - 6. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.
 - 7. Provide residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for cleanout. Use polished stainless steel for ductwork exposed to view and mill stainless steel for ducts where concealed.
 - 8. All visible welds in ductwork between biosafety cabinets, canopy hoods and fume hoods and the ceiling shall be ground and polished.
 - 9. Slope duct toward grilles for moisture-laden ducts. Provide drain and trap at elbow of main moisture exhaust duct system.

D. Grease Duct

1. All grease duct and components shall meet the requirements of NFPA 96 and the Mechanical Code.
2. The minimum requirements for access doors shall be as follows:
 - a. Label all access doors
 - b. Access doors shall be provided at sides or top of the duct, whichever is more accessible.
 - c. Provide access doors at all changes in direction.
 - d. On horizontal ducts at least one opening shall be provided for personnel entry (20"x20"). Where an opening of this size is not possible, openings large enough to permit cleaning shall be provided at a maximum of 12 foot intervals.
 - e. Where personnel entry is not possible, adequate access for cleaning shall be provided at each floor.
3. Slope all grease duct back to the hood / equipment served.
4. Install ducts with proper clearance to combustible and limited-combustible materials. Furnish and install listed duct insulation material when required to provide proper enclosure of ductwork. Include removable sections of insulation around duct access doors. Include an "Access Door" label.

E. Dryer Exhaust Duct

1. All dryer exhaust duct, terminations, and components shall meet the requirements of the Mechanical Code.
2. Do not fasten supports to ductwork with screws or fasteners that penetrate and protrude into the ductwork.
3. Provide fire-stopping around duct penetration in fire-resistance-rated walls or provide a noncombustible wall receptacle for clothes dryer exhaust duct connections.
4. Install an exterior termination approved for use with dryer exhaust applications. Provide with a gravity backdraft damper to prevent debris and pest intrusion. Do not install any mesh screens, cages, grids, or bars over the outlet termination.
5. Exterior termination shall be installed not less than 3 feet in any direction from doors, windows, outside air intakes, attic soffit vents, or any other building openings.
6. For installations of ductwork exceeding 35 feet of equivalent length, install a permanently label within 6 feet of the equipment duct connection that lists the installed installed equivalent length.

F. Hangers and Supports

1. All ductwork supports shall be in accordance with Table 4-1 (rectangular duct) and Table 4-2 (round duct) of the SMACNA Standards, with all supports directly anchored to the building structure.
2. Rectangular duct shall have at least one pair of supports on minimum 8'-0" (eight feet) centers. All horizontal round and flat oval ducts shall have ducts hangers spaced 10'-0" (ten feet) maximum.

3. Lower attachment of hanger to duct shall be in accordance with Table 4-4 of the SMACNA Standards.
4. Vertical ducts shall be supported where they pass through the floor lines with 1-1/2 inch x 1-1/2 inch x 1/4 inch angles for duct widths up to 60 inches. Above 60 inches in width, the angles must be increased in strength and sized on an individual basis considering space requirements.
5. Hanger straps on duct widths 60 inches and under shall lap under the duct a minimum of 1 inch and have minimum of one fastening screw on the bottom and two on the sides.
6. Hanger straps on duct widths over 60 inches shall be bolted to duct reinforcing with 3/8 inch bolts minimum.

3.10 DUCTWORK SYSTEM CLEANING

- A. If the system has been operated without schedule filters or if the integrity of temporary closures has been compromised, Contractor shall have ductwork cleaned according to National Air Duct Cleaners Association (NADCA) Standards by a Certified Regular Member of the NADCA.
- B. For ductwork supplying Clean Rooms or patient care areas, also sanitize the ductwork interior per NADCA standards with a biocidal agent approved by the EPA for use in HVAC systems.
- C. Before turning the installation over to the Owner, Contractor shall certify that the air handling systems have only been operated with scheduled filters in place. Otherwise, Contractor shall present evidence that the ductwork cleaned as required above.

3.11 TESTING

- A. A minimum of 25% of all medium and high pressure duct systems (positive or negative) shall be pressure tested according to SMACNA test procedures (HVAC Air Duct Leakage Test Manual) and ASHRAE Standard 90.1 requirements. The ductwork to be tested shall be 25% of the lineal feet of ductwork mains starting at the air handling unit or fan.
 1. Notify Owner minimum seven (7) calendar days in advance of leakage testing.
 2. Design pressure for testing ductwork shall be determined from the maximum pressure generated by the fan at the nominal motor horsepower selected.
 3. Total allowable leakage shall not exceed 1 percent of the total system design airflow rate.
 4. When partial sections of the duct system are tested, the summation of the leakage for all sections shall not exceed the total allowable leakage.
 5. Leaks identified during leakage testing shall be repaired by:
 - a. Complete removal of the sealing materials.
 - b. Thorough cleaning of the joint surfaces.
 - c. Installation of multiple layers of sealing materials.
 6. The ductwork system to be tested, shall exclude connections downstream of the terminal units (i.e., ductwork shall be capped immediately prior to the terminal units, and tested as described above).

7. After testing has proven that ductwork is installed and performs as specified, the terminal units shall be connected to ductwork and connections sealed with extra care. Contractor shall inform the Owner when joints may be visually inspected for voids, splits, or improper sealing of the joints. If any leakage exists in the terminal unit connections/joints after the systems have been put into service, leaks shall be repaired as specified for other leaks.
- B. All low-pressure duct systems (positive or negative) shall be inspected for visible and audible signs of leakage.
- C. Leaks identified by inspection shall be repaired by
 1. Complete removal of the sealing materials.
 2. Thorough cleaning of the joint surfaces.
 3. Installation of multiple layers of sealing materials.
- D. Discrepancies found during testing and balancing between duct traverses and diffuser/grille readings shall result in re-inspection, repair and retest until discrepancies are eliminated.
- E. Ductwork leakage testing and/or inspection shall be performed prior to installation of external ductwork insulation.

END OF SECTION

SECTION 23 3300 - DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the ductwork accessories indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Equipment Included in This Section
 - 1. Airflow Control Dampers and Spin-In Fittings
 - 2. Flexible Duct
 - 3. Flexible Duct Elbow Supports
 - 4. Flexible Duct Connections
 - 5. Duct Access Doors
 - 6. Screens
 - 7. Duct Test Holes
 - 8. Turning Vanes
 - 9. Remote Balancing Dampers
 - 10. Pressure Relief Doors

1.2 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. AMCA 500D – Laboratory Method of Testing Dampers for Rating
 - 2. AMCA 500L – Laboratory Method of Testing Louvers for Rating
 - 3. NFPA 90A - Installation of Air Conditioning and Ventilating Systems
 - 4. NFPA 101 - Life Safety Code
 - 5. SMACNA - HVAC Duct Construction Standards

1.3 SUBMITTALS

A. Product Data

1. Provide product data for shop fabricated assemblies including, but not limited to, volume control dampers, duct access doors, and duct test holes. Provide product data for hardware used.

PART 2 - PRODUCTS

2.1 GENERAL

- #### **A.**
- All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.2 AIR FLOW CONTROL DAMPERS

A. Acceptable Manufacturers

1. Greenheck
2. Nailor Industries
3. Pottorff
4. Ruskin
5. Tamco
6. United Enertech
7. Louvers & Dampers, Inc.
8. NCA Manufacturing
9. Air Balance

- #### **B.**
- Furnish and install dampers where shown on the Drawings and wherever necessary for complete control of airflow, including all supply, return, outside air, and exhaust branches, "division" in main supply, return and exhaust ducts, and each individual air supply outlet. Where access to dampers through a permanent suspended ceiling (gypsum board) is necessary, the Contractor shall be responsible for the proper location of the access doors.

- #### **C.**
- Dampers larger than three (3) square feet in area shall be controlled by a self-locking splitter damper assembly.

- #### **D.**
- Volume damper blades shall not exceed 48 inches in length or twelve inches in width and shall be of the opposed interlocking type. The blades shall be of not less than No. 16 gauge galvanized steel supported on one-half inch diameter rust-proofed axles. Axle bearings shall be the self-lubricating ferrule type.

- E. Volume dampers and other manual dampers shall be carefully fitted, and shall be manually controlled by damper regulators as follows:
1. On exposed non-insulated ductwork the locking quadrant shall be made with a base plate of 16-gauge cold-rolled steel and a heavy die cast handle designed with a 3/8 inch bearing surface. A 1/4 inch-20 zinc plated wing nut shall firmly lock the handle in place.
 2. On exposed externally insulated ductwork the regulator shall be 4-1/4 inch diameter, for 1/2 inch rod, designed for use on duct with insulation thickness specified for duct, and shall have four (4) 3/16 inch holes provided to rivet or screw regulator to the duct surface. The flange that covers the raw edge of the insulation shall be high enough so that it slightly compresses the insulation and holds insulation in place. The handle shall be 3/8 inch above the flange, and shall easily turn without roughing up the insulation.
 3. On concealed ductwork above inaccessible ceilings, the regulator shall be 2-5/8 inch diameter chromium plated cover plate that telescopes into the base, for 1/2 inch rod. Regulator shall be cast into a box for mounting in ceilings. Base shall be 1-1/2 inch deep. The cover shall be secured by two (2) screws that can be easily removed for damper adjustment.
 4. Furnish and install end bearings for the damper rods on the end opposite the quadrant.
- F. Spin-in fittings may be used for duct taps to air devices and shall include dampers on all ducts to air devices (diffusers and grilles) even though a volume damper is specified for the air device. Spin-in fittings shall be similar to Flexmaster FLD with BO3 including a 2 inch build-out, nylon bushings, locking quadrant similar to Duro Dyne KR-3, and a 3/8 inch square rod connected to the damper with U-bolts. Spin-in fittings shall be sealed at the duct tap with sealant as specified herein. Determine location of spin-in fittings after terminal units are hung or after location of light fixtures are confirmed to minimize flexible duct lengths and sharp bends.

2.3 FLEXIBLE DUCTS

- A. Acceptable Manufacturers
1. Flexmaster U.S.A., Inc.
 2. McGill AirFlow LLC.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
 4. Thermaflex
- B. Insulated, Flexible Duct:
1. Certifications:
 - a. UL 181,
 - b. ETL Class 1
 - c. NFPA 90A and 90B
 - d. Greenguard
 2. Construction:
 - a. Single ply inner liner constructed of chlorinated polyethylene
 - b. Corrosion resistant galvanized steel core
 - c. Fibrous glass insulation with a minimum value of R-6.

- d. Polyethylene vapor barrier film
- 3. Pressure Rating: 6-inch wg positive and 2-inch wg negative
- 4. Maximum Air Velocity: 5000 fpm
- 5. Temperature Range: -10° F to 160° F
- 6. Flame spread rating less than 25
- 7. Smoke developed rating of less than 50

2.4 FLEXIBLE DUCT ELBOW SUPPORTS

- 1. Acceptable Manufacturers
 - a. Build Right Products - FlexRight
 - b. Thermaflex – FlexFlow Elbow
 - c. RPS - FlowRite
- 2. Construction
 - a. Universal-mount, 1-piece, fully adjustable, radius-forming brace to support 4-inch through 16-inch diameter flexible air ducts.
 - b. Classified: UL 2043.
 - c. Material: 100 percent recycled copolymer polypropylene.
 - d. Support Frame Radius: 8 inches.
 - e. Compliance for Flexible Duct Radius:
 - 1) SMACNA HVAC Duct Construction Standards.
 - 2) ASHRAE Advanced Energy Design Guides.
 - 3) ADC Flexible Duct Performance and Installation Standards.

2.5 FLEXIBLE CONNECTIONS

- A. Where ducts connect to equipment, flexible connections shall be made using “Flexmaster TL-M” or “Ventglas” fabric that is temperature-resistant, fire-resistant, waterproof, mildew-resistant and practically airtight, weighing approximately thirty ounces (30 oz.) per square yard.
- B. Material used outdoors shall be resistant to ultra-violet sunrays. There shall be a minimum of 1/2" slack in the connections, and a minimum of 2 1/2" inches distance between the edges of the ducts. This does not apply to air handling units with internal isolation. A more rugged flexible material that is resistant to ultra-violet rays needs to be used when connecting an exhaust fan or exhaust air plenum to ductwork.

2.6 DUCT ACCESS DOORS

- A. Acceptable Manufacturers
 - 1. Greenheck
 - 2. Kees
 - 3. Nailor Industries
 - 4. Pottorff

5. Ruskin
- B. Furnish and install in the ductwork, hinged rectangular, or round "spin-in" access doors to provide access to the following items:
1. Major changes of direction in horizontal ducts connected to cooking equipment hoods and vertical grease duct risers as required by code for system cleaning. Refer to NFPA 96 and Specification Section 233113 for additional requirements.
 2. Motor operated dampers.
 3. Manually operated volume control devices.
 4. Mixed air plenums
 5. In-line damper actuators installed in air stream.
 6. Heating coils (install upstream)
 7. Duct mounted humidifiers (upstream and downstream)
 8. Airflow stations
 9. Air filters replacement doors
 10. All locations where operating parts of any kind are installed in the ductwork and elsewhere as indicated on the plans.
- C. Access doors are not required, where a manually operated damper has an exposed damper regulator, with an indicating quadrant.
- D. Where ductwork is insulated, access doors shall be double skin doors with 1" of insulation in the door.
- E. Door Size
1. Door opening shall be adequately sized and positioned to allow for maintenance / replacement of any components located inside the ductwork. Based on the maximum duct dimension the following access door size minimum requirements are as follows:
 - a. 8" max duct dimension - One (1)-Hand or Inspection Access: 8" x 6" access door
 - b. 12" max duct dimension - Two (2)-Hand Access: 12" x 10" or 10" diameter access door
 - c. 18" max duct dimension - Head and Hand Access: 16" x 12" or 16" diameter access door
 - d. 26" max duct dimension - Head and Shoulders Access: 24" x 16" or 22" diameter access door
 - e. 30" max duct dimension - Body Access: 26" x 14" or 24" diameter access door
 - f. All other sizes - Body plus Ladder Access: 26" x 18" or 26" diameter access door
 2. For duct access doors smaller than 16" x 12" Ventlok No. 90 sash style latches shall be used. For duct access doors 16" x 12" or larger Ventlok No. 260 latches shall be used.
 3. A minimum of two latches are required for all access doors are required. Provide additional latches as needed to ensure the access door is sealing properly and there is not noticeable air leakage or air noise associated with the access door.

- F. All access doors shall have a continuous gasket.
- G. Round access doors shall be "Inspector Series" spin-in type door as manufactured by Flexmaster USA.
- H. Where access doors are installed above a gyp board ceiling, this Contractor shall be responsible for providing and installing a ceiling access door of adequate size to utilize the access door and position it in the proper location.

2.7 SCREENS

- A. Furnish and install screens on all duct, fan, etc., openings furnished by this Contractor which lead to, or are located outdoors.
- B. Screens shall be No. 16 gauge, 1/2" mesh in removable frame as noted on drawings. Mesh and frame to be galvanized steel or aluminum as noted on the drawings.
- C. Provide safety screens meeting OSHA requirements for protection of maintenance personnel on all fan inlets and fan outlets to which no ductwork is connected.

2.8 TURNING VANES

- A. Acceptable Manufacturers
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. METALAIRE, Inc.
 - 4. SEMCO Incorporated.
 - 5. Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. Contractor fabricated turning vanes are acceptable provided they meet the requirements in this section.
- E. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- F. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.9 REMOTE DAMPER OPERATORS

- A. Acceptable Manufacturers
 - 1. Pottorff; a division of PCI Industries, Inc.
 - 2. Ventfabrics, Inc.
 - 3. Young Regulator Company
 - 4. United Enertech
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Brass
- D. Cable: Stainless steel
- E. Wall-Box Mounting: Recessed, 3/4 inches deep Recessed, 2 inches deep Surface
- F. Wall-Box Cover-Plate Material: Stainless steel
- G. Coordinate the location of the wall box with Architect / Engineer prior to installation.
- H. Required Locations:
 - 1. Diffusers installed in hard ceilings.
 - 2. Where dampers are not accessible due to congested ceilings.

2.10 PRESSURE RELIEF ACCESS DOOR

- A. Acceptable Manufacturers
 - 1. Greenheck
 - 2. Kees
 - 3. Pottorff
 - 4. Ruskin
- B. Door and Frame Material: Galvanized sheet steel.
- C. Door: Single wall Double wall with insulation fill with metal thickness applicable for duct pressure class.
- D. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
- E. Factory set at 3-inch wg
- F. Doors close when pressures are within set-point range.
- G. Hinge: Continuous piano.

- H. Latches: Cam.
- I. Seal: Neoprene or foam rubber.
- J. Insulation Fill: 1-inch-thick, fibrous-glass or polystyrene-foam board.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Volume Dampers
 - 1. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 2. Install steel volume dampers in steel ducts.
 - 3. Install aluminum volume dampers in aluminum ducts.
 - 4. Set dampers to fully open position before testing, adjusting, and balancing.
 - 5. Position damper adjacent to the branch connection to the main when possible. Locate as far as from the opening it serves in all other instances.
- D. Test Holes
 - 1. Install test holes at fan inlets and outlets and elsewhere as indicated.
 - 2. Install duct test holes where required for testing and balancing purposes.
 - 3. Install test holes in locations as required to measure pressure drops across each item in the system, e.g., outside air louvers, filters, fans, coils, intermediate points in duct runs, etc.
- E. Duct Access Doors
 - 1. Install duct access doors on sides or bottoms of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - a. On both sides of duct coils.
 - b. Upstream and downstream from duct filters.
 - c. At outdoor-air intakes and mixed-air plenums.
 - d. At drain pans and seals.

- e. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - f. At each change in direction and at maximum 50-foot spacing.
 - g. Upstream or downstream from duct silencers.
 - h. Control devices requiring inspection.
 - i. Elsewhere as indicated.
2. Install access doors with swing against duct static pressure.
3. Label access doors according to Division 23 Section "Mechanical Identification" to indicate the purpose of access door.

F. Flexible Connections

1. Install flexible connectors to connect ducts to equipment.
2. Flexible fabric connections installed at equipment exterior to the building shall be rated UV exposure and suitable for exterior use per ASTM G155 testing requirements. Metal for these connections shall be aluminum or stainless steel, galvanized connections shall not be allowed.
3. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment. Cover connections to medium and high pressure fans with leaded vinyl sheet, held in place with metal straps.
4. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

G. Flexible Duct

1. Connect terminal units to supply ducts directly or with maximum 36-inch lengths of flexible duct. Do not use flexible ducts to change directions.
2. Fittings on terminal units and on sheet metal duct shall have flexible duct core slipped over duct and coupling or clamp tightened, then connection sealed with sealant. Insulation of flexible duct shall be slipped over connection to point where insulation abuts terminal unit or insulation on duct.
3. These insulation connections shall be sealed by embedding fiberglass tape in the sealant and coating with more sealant to provide a vapor barrier.
4. The terminal ends of the duct core shall be secured by compression coupling or stainless steel worm gear type clamp.
5. Connect diffusers to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
6. Support flexible ducts as per SMACNA standards to prevent sags, kinks and to have 90 degree turns.

H. Flexible Duct Elbow Supports

1. Install flexible duct elbow supports in accordance with manufacturer's instructions.

2. Install flexible duct elbow supports over outer jacket of flexible ducts to form smooth, 90-degree bends to eliminate flexible duct kinks and airflow restrictions.
 3. Make bends in flexible ducts with minimum of 1-duct diameter centerline radius.
 4. Install flexible duct elbow supports at flexible duct 90-degree bends at following locations:
 - a. Diffusers.
 - b. Grilles.
 - c. Registers.
 - d. Duct take-offs and taps.
 - e. Air devices with round inlets and outlets.
 - f. HVAC equipment with round inlets and outlets.
 - g. As indicated on the Drawings.
- I. Balancing Dampers
1. Provide balancing dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing.
 2. Provide all dampers furnished by the BAS Provider in strict accordance with manufacturer's written installation instruction and requirements of these Specifications.
- J. Backdraft Dampers
1. Provide backdraft dampers on exhaust fans or exhausts ducts where indicated. Install dampers so that they will open freely.
- K. General Installation
1. All installation shall be in accordance with manufacturer's published recommendations.
 2. Furnish and install Ventlok No. 699 instrument test holes in the return air duct and in the discharge duct of each fan unit.
 3. Access doors as specified elsewhere shall be provided for access to all parts of the fire and combination fire and smoke dampers. Doors shall open not less than 90 degrees following installation and shall be insulated type where installed in insulated ducts.

END OF SECTION

SECTION 23 3425 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all work required to provide and install the Power Ventilators indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Equipment Included in This Section:
 - 1. Centrifugal roof ventilators.

1.2 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings
 - 2. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings
 - 3. AMCA 99 - Standards Handbook
 - 4. ACMA 203 - Fan Application Manual - Field Performance Measurements
 - 5. AMCA 204 - Balance Quality and Vibration Levels For Fans
 - 6. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
 - 7. AMCA 300 - Reverberant Room Method for Sound Testing of Fans
 - 8. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data
 - 9. NEMA MG1 - Motors and Generators
 - 10. NFPA 70 - National Electrical Code
 - 11. SMACNA - HVAC Duct Construction Standards - Metal and Flexible
 - 12. UL 705 – Power Ventilators

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 - 1. Certified fan performance curves with system operating conditions indicated

2. Certified fan sound-power ratings
 3. Motor ratings and electrical characteristics, plus motor and electrical accessories
 4. Material thickness and finishes, including color charts
 5. Dampers, including housings, linkages, and operators
 6. Roof curbs
 7. Fan speed controllers
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Wiring Diagrams: Power, signal, and control wiring.
 2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
- C. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal. The sound power levels must not exceed those indicated on Drawings.
- D. Fabrication: Conform to AMCA 99.
- E. Performance Base: 50 feet above sea level.
- F. Fans shall be capable of operating stably at reduced loads imposed by means of variable speed drives.
- G. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- H. UL Standard: Power ventilators shall comply with UL 705.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.6 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acme
 - 2. Twin City
 - 3. Greenheck
 - 4. Loren Cook Company.
 - 5. Pennbarry
 - 6. Soler & Palau
 - 7. Captiveaire
- C. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- D. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
 - 1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains and grease collector.
 - 2. Hinged Sub-base: Galvanized-steel hinged arrangement permitting service and maintenance.

- E. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- F. Accessories
 - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
 - 2. Disconnect Switch: Non-fusible type, with thermal-overload protection mounted inside outside fan housing, factory wired through an internal aluminum conduit.
 - 3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
 - 4. Gravity Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
- G. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch-thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
 - 1. Configuration: Self-flashing for membrane roofs; with built-in cant for bituminous or built-up roofs
 - 1. General exhaust fan roof curb Height: Minimum 12 inches above finished roof level. Contractor to field coordinate required curb height based on roof insulation thickness.
 - 2. Grease exhaust fan roof curb height: Minimum 18" above finished roof level. Contractor to field coordinate required curb height based on roof insulation thickness.
 - 3. Pitch Mounting: Manufacture curb for roof slope.
 - 4. Metal Liner: Galvanized steel.
 - 5. Mounting Pedestal: Galvanized steel with removable access panel.
 - 6. Vented Curb: Unlined with louvered vents in vertical sides.
- H. Capacities and Characteristics:
 - 1. As scheduled on Drawings

2.2 MOTORS

- A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

2.3 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.
- C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- D. Install units with clearances for service and maintenance.
- E. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and verify connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust damper linkages for proper damper operation.
 - 6. Verify lubrication for bearings and other moving parts.
 - 7. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.

8. Shut unit down and reconnect automatic temperature-control operators.
 9. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- C. Replace fan and motor pulleys as required to achieve design airflow.
- D. Lubricate bearings.

END OF SECTION

SECTION 23 3700 – AIR INLETS AND OUTLETS

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the air inlets and outlets indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Equipment Included in This Section:
 - 1. Grilles, Registers and Diffusers

1.2 REFERENCES

- A. Equipment and Installation shall meet the requirements outlined in the following references:
 - 1. ACGIH: American Conference of Governmental Industrial Hygienists
 - 2. AMCA: Air Movement and Control Association
 - 3. NFPA: National Fire Protection Association
 - 4. SMACNA: Sheet Metal and Air Conditioning Contractors National Association, Inc.
 - 5. UL: Underwriters Laboratories, Inc.
 - 6. AMCA 500 – Test Method for Louvers, Dampers and Shutters
 - 7. ANSI/NFPA 90A – Installation of Air Conditioning and Ventilating SystemsASHRAE 70 – Method of Testing for Rating the Air Flow Performance of Outlets and Inlets

1.3 SUBMITTALS

- A. Product Data: (For Each Product)
 - 1. Catalog cut-sheets
 - 2. Indicate materials of construction, finish and mounting details
 - 3. Mounting details
 - 4. Installation instructions
 - 5. Performance data (at actual operating conditions)
 - a. Throw and drop
 - b. Static-pressure drop
 - c. Noise ratings

6. Inlet and Outlet Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

- B. Submit color and finish samples for all louvers.

1.4 QUALITY ASSURANCE

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. Grilles, registers and diffusers shall be as scheduled on the Drawings. Grilles, registers and diffusers shall be provided with sponge rubber or soft felt gaskets where noted on the Drawings. Grilles, slot diffusers and laminar flow bars shall not be internally insulated.
- C. If a manufacturer other than the one scheduled is used, the sizes shown on the Drawings shall be checked for performance, noise level, face velocity, throw, pressure drop, etc., before the submittal is made. Selections shall meet the manufacturer's own published data for the above performance criteria. The throw shall be such that the velocity at the end of the throw in the five (5) foot occupancy zone will not exceed 50 fpm or be less than 25 fpm except where indicated otherwise. Noise levels shall not exceed those published in ASHRAE for the type of space being served (NC level).
- D. Locations of air distribution devices on Drawings are approximate and shall be coordinated with other trades to make symmetrical patterns and shall be influenced by the established general pattern of the lighting fixtures or architectural reflected ceiling plan, but primarily located to maintain proper air distribution. Where called for on Drawings, grilles, registers and diffusers shall be provided with deflecting devices and manual dampers. These grilles, registers, and diffusers shall be the standard product of the manufacturer, and subject to review by the Architect.
- E. Provide a frame compatible with the type of ceiling or wall in which the devices are installed. Refer to Architectural Drawings for exact type of ceiling specified.
- F. Coordinate color and finish of the devices with the Architect.

PART 2 - PRODUCTS

2.1 GRILLES, REGISTERS, AND DIFFUSERS

- A. Acceptable Manufacturers
 1. Anemostat
 2. Carnes
 3. Krueger
 4. Nailor
 5. Price
 6. Titus

7. Tuttle & Baily

B. Square Panel Face diffuser – Supply and Return

1. Architectural diffuser with a square panel face, centered within a square housing. The exposed surface of the face panel shall be smooth, flat and free of visible fasteners.
2. The diffuser shall have a 22-gauge steel face panel that captures a secondary 22-gauge panel. The panel shall project a maximum of 1/4" below the outside border of the diffuser.
3. For area of high moisture content or requiring non-ferrous materials, the diffuser shall be constructed of 22-gauge aluminum. This includes a 22-gauge aluminum panel that captures a secondary panel.
4. The face panel size shall be a minimum of 18" x 18" for 24" x 24" diffusers and 9" x 9" for 12" x 12" diffusers.

C. Perforated Face Ceiling Diffusers – Supply

1. Perforated face with fully adjustable pattern and removable face.
2. Perforated face to consist of 3/16" diameter holes on 1/4" staggered centers. A minimum of 51% free area shall be available.
3. Fabricate completely of 22-gauge steel with a baked enamel off-white finish.
4. The diffuser shall have a 22-gauge steel face panel that captures a secondary 22-gauge panel. The panel shall project a maximum of 1/4" below the outside border of the diffuser.
5. For areas of high moisture content or requiring non-ferrous materials, the diffuser shall be constructed of 22-gauge aluminum.
6. Provide multi-louvered equalizing grid where noted on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

1. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
2. All installation shall be in accordance with manufacturer's published recommendations.

B. Diffusers

1. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, reflected ceiling plans, symmetry, and lighting arrangement.

2. Install air outlets and inlets to ductwork with airtight connection.
3. Provide balancing dampers on duct take-off to diffusers, grilles and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.
4. Provide all specialties and frames for air distribution devices as required for proper installation in ceiling type as indicated on Architectural Drawings. Provide all cutting and patching of T-bars, gypsum board, and other ceiling systems as required for installation of air devices.

C. Special Requirements

1. Paint ductwork visible behind air outlets and inlets matte black. Refer to Division 09.

END OF SECTION

SECTION 23 3725 - KITCHEN HOODS

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the air inlets and outlets indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Equipment Included in This Section:
 - 1. Type I Commercial Kitchen Hoods
 - 2. Fire Suppression Systems
 - 3. Control Systems
 - 4. Lighting

1.2 REFERENCES

- A. Equipment and Installation shall meet the requirements outlined in the following references:
 - 1. AMCA: Air Movement and Control Association
 - 2. NFPA: National Fire Protection Association
 - 3. SMACNA: Sheet Metal and Air Conditioning Contractors National Association, Inc.
 - 4. UL: Underwriters Laboratories, Inc.
 - 5. ANSI/NFPA 90A – Installation of Air Conditioning and Ventilating Systems
 - 6. ASHRAE 70 – Method of Testing for Rating the Air Flow Performance of Outlets and Inlets

1.3 SUBMITTALS

- A. Product Data:
 - 1. Standard hoods.
 - 2. Filters/baffles.
 - 3. Fire-suppression systems.
 - 4. Lighting fixtures.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer.
 - 1. Show plan view, elevation view, sections, roughing-in dimensions, service requirements, duct connection sizes, and attachments to other work.

2. Show cooking equipment plan and elevation to confirm minimum code-required overhang.
3. Indicate performance, exhaust and makeup air airflow, and pressure loss at actual Project-site elevation.
4. Show control cabinets.
5. Show fire-protection cylinders, piping, actuation devices, and manual control devices.
6. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
7. Design Calculations: Calculate requirements for selecting seismic restraints.
8. Wiring Diagrams: Power, signal, and control wiring.
9. Piping Diagrams: Detail fire-suppression piping and components and differentiate between manufacturer-installed and field-installed piping. Include roughing-in requirements for drain connections. Show cooking equipment plan and elevation to illustrate fire-suppression nozzle locations.
10. Installing fire suppression contractor shall submit the Engineer/Owner approved shop drawings and project plans to the State Fire Marshal for final approval prior to installation.

1.4 QUALITY ASSURANCE

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. Coordinate color and finish of the devices with the Architect.
- C. Coordinate trim pieces and skirts required around the hood to match the actual space conditions.

1.5 DEFINITION

- A. Listed Hood: A hood, factory fabricated and tested for compliance with UL 710 by a testing agency acceptable to authorities having jurisdiction.
- B. Type I Hood: A hood designed for grease exhaust applications.

PART 2 - PRODUCTS

2.1 TYPE I HOODS

- A. Acceptable Manufacturers
 1. Captive Aire
 2. Greenheck

3. Halton

B. Construction

1. Shall be type 430 stainless steel with a #3 or #4 polish, where exposed.
2. The manufacturer and ETL shall determine individual component construction. Construction shall be dependent on the structural application to minimize distortion and other defects.
3. All seams, joints and penetrations of the hood enclosure to the lower outermost perimeter, which directs and captures grease-laden vapor and exhaust gases, shall have a liquid-tight continuous external weld in accordance with NFPA 96.
4. Hood shall be wall type with a minimum of four connections for hanger rods. Corner hanging angles have a 5/8" x 1-1/2" slot pre-punched at the factory, allowing hanging rods to be used for quick and safe installation.
5. Ventilator shall be furnished with U.L. classified high efficiency stainless steel baffle filters, supplied in size and quantity as required by ventilator. The filters shall extend the full length of the hood and the filler panels shall not be more than 6" in width.
6. Exhaust duct collar to be 4" high with 1" flange. Duct sizes, CFM and static pressure requirements shall be as shown on drawings. Static pressure requirements shall be precise and accurate; air velocity and volume information shall be accurate within 1-ft increments along the length of the ventilator.
7. The hood shall have:
 - a. A double wall insulated front to eliminate condensation and increase rigidity on 30"-36" wide sizes. The insulation shall have a flexural modulus of 475 EI, meet UL 181 requirements and be in accordance with NFPA 90A and 90B.
 - b. An integral baffle to direct grease laden vapors toward the exhaust filter bank.
 - c. Removable grease cup for easy cleaning.
8. The hood shall be ETL Listed as "Exhaust Hood Without Exhaust Damper", ETL Sanitation Listed and built in accordance with NFPA 96. The hood shall be listed for 450°F cooking surfaces at 150 CFM/ft and 600°F cooking surfaces at 200 CFM/ft.
9. All seams shall be welded and have stainless steel on exposed surfaces.
10. Perforated diffuser plates shall be included in the design, to provide even air distribution.
11. Unexposed surfaces shall be constructed of aluminized steel.
12. Plenum shall be insulated to prevent condensation.
13. Accessories
 - a. Utility Cabinet
 - b. Enclosure Panels
 - 1) Backsplash
 - 2) Right and left end panels
 - 3) Field wrapper (front, left, right)

14. Fire Suppression System

- a. Acceptable Manufacturers
 - 1) Iowa Fire Equipment Company
 - 2) Captive Aire
 - 3) Greenheck
 - 4) Halton
- b. Ansul fire suppression system
- c. Pre-piped in hood utility cabinet to discharge nozzles
- d. Includes the following components:
 - 1) Tank
 - 2) Detection
 - 3) Release mechanism
 - 4) Micro switches
 - 5) Pull station

15. Lighting and Power

- a. U.L. incandescent light fixtures with clear thermal & shock resistant globes. Lights shall be installed and pre-wired to a junction box.
- b. The light fixtures shall be installed with a maximum of 4'-0" spacing on center and allow up to a 100 watt standard light bulb.
- c. Unit mounted light switch

16. Controls

- a. Provide hood with a unit mounted controller that includes the following functions:
 - 1) Exhaust fan control
 - 2) Lighting control
 - 3) Duct mounted temperature sensor
 - 4) Room temperature sensor
 - 5) Interlock with fire suppression system
 - 6) Interlock with fire alarm / building automation system
- b. Duct mounted temperature sensor shall activate the exhaust fan (on/off) based on differential between duct temperature and room temperature. Controller shall also allow for manual operation of the fan and lighting controls.
- c. During fire mode, unit mounted controller to operate exhaust fan and turn off the lights. Include a relay to interface with fire alarm system to turn supply airflow to the space off during fire mode.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

- 1. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- 2. All installation shall be in accordance with manufacturer's published recommendations.

3. Equipment start-up shall be performed in the presence of the equipment vendor and installing fire suppression contractor.

END OF SECTION

SECTION 23 7415 – ROOFTOP AIR HANDLING UNITS (3-27.5 TONS)

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the following Rooftop Air Handling Units indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Equipment Included in this Section
 - 1. Gas Fired, DX Cooling, Rooftop Units

1.2 REFERENCES

- A. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed withing the following references:
 - 1. AMCA, ANSI, ARI, ASTM, and NEC standards and codes applicable to rooftop air handling units.
 - 2. ASHRAE 90.1 – Energy Standard for Buildings Except Low High Rise Residential Buildings
 - 3. ASHRAE 52.2 – Method of Testing General Ventilation Air-Cleaning Devices Used for Removal Efficiency
 - 4. ANSI/ASHRAE Standard 135 BacNet – A Data Communication Protocol for Building Automation and Control Network
 - 5. NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems.

1.3 SUBMITTALS

- A. Product Data
 - 1. Provide literature that indicates dimensions, weight, loading, clearances, capacities, gauges, thickness, and finishes of materials electrical characteristics and connections.
 - 2. Rigging, installation, testing, start-up and operating instructions, maintenance data including type and quantity of oil and refrigerant change (pounds), parts lists, and troubleshooting guide.
 - 3. Data on energy input versus cooling load output from 100 percent to 20 percent of full load with constant entering condenser air temperature. Data on heating input, heating output, and AFUE values.
 - 4. Information about control and wiring diagrams.
 - 5. Product test data on sound power levels for both fan inlet and outlet at the rated design capacity.

6. Operating data such as fans speeds, compressor LRA and RA, sound levels
7. Product data on special condenser coating.
8. Product data on all condenser fans accessories such as controls.

1.4 QUALITY ASSURANCE

- A. The design of the unit shall be AGA and ARI certified as combination heating-cooling units for rooftop installation.
- B. Unit construction shall comply with ASHRAE 15 safety code, NEC, and UL applicable codes.
- C. Cooling capacity ratings shall be in accordance with ARI standards 210/240, most recent edition.
- D. Insulation and adhesive shall meet NFPA 90A requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, and protect and handle products to the Project Site under provisions of Division 01 and Division 20.
- B. Accept products on Site in factory-fabricated protective containers or coverings, with factory-installed shipping skids and lifting lugs. Inspect for damage.
- C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.
- D. Check and maintain equipment on monthly basis to ensure equipment is being stored in accordance with manufacturer's recommended practices. Storage record shall be maintained that indicates above requirements have been met.

1.6 EXTRA MATERIALS

- A. Provide an additional replacement set of filters.

1.7 WARRANTY

- A. Units shall be furnished with full coverage warranty against defects in materials. Warranty on the complete unit shall be for one (1) year from Substantial Completion date.
- B. Component Warranties from date of Substantial Completion
 1. Compressors: five (5) years
 2. Controls: three (3) years
 3. Heat Exchangers: ten (10) years
 4. Other System Components: eighteen (18) months

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. CaptiveAire– Paragon
- B. Trane – Precedent (3-10 tons)
- C. Trane – Voyager 2 (12.5-25 tons)
- D. Daikin – Rebel (3-28 tons)
- E. Carrier – Weatherexpert (3-23 tons)
- F. York – Predator (3-12.5 tons)

2.2 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. The packaged unit shall perform to manufacturer's product data, installation instructions, start-up instructions and maintenance information indicated by all Specification Sections, and Contract Documents with supplementary items necessary for proper operation.
- C. Air cooled unit shall consist of hermetic scroll compressor component utilizing R-410A, evaporator coil, air-cooled condenser coil, condenser fans, supply fan, vibration isolation assemblies, and microprocessor control center.
- D. Factory assembled air-cooled packaged DX air conditioning unit using a refrigerant charge (R454B) with the following construction:
 - 1. Factory control and electrical wiring and piping shall be contained within the unit cabinet.
 - 2. Access doors with galvanized or thermoplastic hinges and lockable handles.
 - 3. Compressors and unit controls contained within single isolated compartment.
 - 4. Scroll compressors installed on sheet metal deck with rubber isolation mounts for quiet efficient operation.
 - 5. Compressor isolation valves.
 - 6. DX evaporator coil(s).
 - 7. Stainless steel gas heat exchanger
 - 8. Fan motors
 - 9. Direct drive condenser fan(s).
 - 10. Bottom return and supply air

11. Roof sloped for proper drainage
 12. Single point power connection
 13. Thermostatic expansion valves on DX coils
 14. Manual reset high pressure cutoffs
 15. Automatic reset low pressure cutoffs
 16. Refrigerant leak detection system
 17. Run test report, wiring diagram, installation manual and start-up form in control access compartment.
 18. 120 v, 15a powered GFI convenience outlets.
- E. Optional equipment as indicated on the Drawings
1. Power exhaust fan and economizer
 2. Smoke detectors in return and/or supply air
 3. Phase and brown-out protection
 4. Disconnect switch
 5. Humidity control
- F. Compressor shall have load capacity ratings per the requirements ARI 210/240.
- G. Unit efficiency shall be in compliance with the requirements of the International Energy Conservation Code ASHRAE 90.

2.3 CABINET AND INSULATION

- A. G90 galvanized cabinet.
- B. The cabinet housing shall be constructed of heavy gauge galvanized steel framework covered with galvanized steel sheet casing. Casing metal shall be finished with weather-resistant finish paint.
- C. Refrigeration components and compressor shall be accessible through removable louvered panels as standard. All access doors and panels shall have neoprene gaskets.
- D. Unit base shall be watertight with heavy gauge formed load bearing members and curb overhang.
- E. Provide steel lifting lugs to allow placement of the unit using a crane and sling.
- F. The weatherproof cabinet of the indoor air section shall have thermal breaks to prevent condensation on any cabinet surface exposed to outside atmosphere conditions.

- G. If the unit is not placed on a roof, make provisions to elevate and support the unit off the ground or grade level to protect unit from standing in water.

2.4 COMPRESSORS

- A. Each scroll compressor shall be fitted with low ambient crankcase heater, vibration isolators, refrigerant dryer, external connections for external oil level control if multiple compressors are required, motor winding protection, high and low pressure cutouts, plus any other protective or operating device or fitting required and provided as standard by the compressor manufacturer. Compressors shall be designed for continuous or cycling operation at the specified design conditions without detrimental effect.
- B. Each compressor shall be industrial grade, energy efficient direct drive scroll type. The motor shall have a suction gas cooled hermetic design. Compressor shall have oil sight glass and oil charging valve. Crankcase heaters will be standard on each compressor to minimize amounts of liquid in the oil sump when unit is off.
- C. Provide with thermostatic motor winding temperature control to protect against excessive motor temperatures resulting from over-/under-voltage or loss of charge. Provide high and low pressure cutouts, and reset relay.
- D. Provide factory installed compressor lockout thermostat to prevent compressor operation at low ambient conditions.
- E. Provide coil frost protection compressor unloading based on refrigerant circuit suction temperature to prevent coil frosting with minimum energy usage.
- F. Provide replaceable core, liquid line filter dryers with refrigerant isolation valves. Dryer housings and isolation valves shall be located in the unit condenser section, and be easily accessible for routine service.

2.5 FANS, MOTORS AND DRIVES

- A. Indoor airflow and external static pressure capabilities shall be no less than the values indicated on the drawings. Internal static pressure shall include a minimum allowance for 2-inch pleated type filters.
- B. All fan(s) and motor(s) shall be in compliance with the fan power limitation in Table 6.5.3.1 of ASHRAE 90.1.
- C. Outdoor fans shall be direct drive, shaft mounted propeller type, statically and dynamically balanced. Outdoor fan motor(s) shall be TEFC weather resistant with permanently lubricated bearings.
- D. Indoor fan motor(s) shall be TEFC with sealed lubricated bearings. Indoor fans shall be statically and dynamically balanced and configured as listed below:
 - 1. 3-10 ton units: ECM direct drive, shaft mounted centrifugal type
- E. Provide airfoil type double width, double inlet supply fan(s) with fixed-pitch drive assemblies. Provide thrust restraint isolation on the fan housing/fan board to assure smooth fan startup transition and operation.

- F. Provide forward curved type, double width, double inlet exhaust fans with variable speed drive fixed-pitch drive assemblies.
- G. Provide plenum type with air foil blade, single width, single inlet relief fan with fixed-pitch drive assemblies. Dynamically balance all fans, and the unit's running fan assembly, or assemblies, (fan mounted on actual shaft, bearings, and in scroll housing for double width, double inlet fans) to assure smooth operation of the fans and associated assemblies. Balancing of the fan only shall not be acceptable.
- H. Mount fan motor(s) and fan(s) on a common base assembly and isolated from unit with 1" spring isolation.
- I. Fan shaft(s) shall be mounted on grease lubricated bearings (ball bearings for supply fan, ball or roller bearing for return/exhaust). Bearings shall be fitted with extended lubrication lines and lubrication ports external to the fan compartment(s) to facilitate ease of maintenance.

2.6 AIR FILTERS

- A. Front or side loaded filters shall be easily accessible for removal through access panels or doors.
- B. Filters shall match the performance information listed in the schedule on the drawings.
- C. Filter face velocity shall not exceed 350 fpm.

2.7 COILS – GENERAL

- A. Coils shall be standard construction copper tubes with aluminum fins. All copper work shall be brazed. Coils shall be factory pressure tested to 500 psi.
- B. Indoor coils shall be capable of the performance indicated on the drawings with no carry-over of condensate.
- C. Coils shall have a maximum fin spacing of 12 fpi.
- D. Coils shall have a maximum face velocity of 550 fpm.
- E. Indoor coils shall be equipped with a sloped, corrosion resistant condensate pan terminating at a condensate drain located outside the unit cabinet.

2.8 EVAPORATOR COILS

- A. Units smaller than 7.5 tons nominal capacity shall be required to have part-load/staged refrigeration capability. Each unit of 7.5 to 20 tons refrigeration capacity shall have variable speed compressors for modulating cooling control.
- B. The refrigeration system shall be equipped with filter dryers on the liquid lines and service valves with gauge port connections on the discharge and suction lines.
- C. Provide modulating hot gas reheat option consisting of hot gas reheat coil located on the leaving air side of the evaporator coil and pre-piped to circuit 1 along with a staged on/off reheat valve.

2.9 AIR-COOLED CONDENSER

- A. Provide heavy duty aluminum fins mechanically bonded to copper tubes.
- B. Provide subcooling circuit(s) integral with condenser coils to maximize efficiency and prevent premature flashing of liquid refrigerant, to a gaseous state, ahead of the expansion valve.
- C. Provide vertical discharge, direct drive, fans with steel blades, and three phase totally enclosed, air over cooled, motors. Fans shall be statically and dynamically balanced. Motors shall be permanently lubricated, with built-in current and thermal overload protection.
- D. Provide factory installed wire guards around perimeter of condensing section to protect the condenser coils, refrigerant piping and control components from damage resulting from hail, flying debris, and vandalism. Course wire mesh is not an acceptable material for coil guards.
- E. Condenser coils shall not exceed 13 fins per inch density in order to permit routine cleaning and prevent excessive air pressure drop across the coils.

2.10 GAS HEAT EXCHANGERS

- A. Units shall be equipped with a stainless steel natural gas burning heat exchanger of corrosion resistant components to provide efficient heating operation. Burner shall be designed for natural gas supply at 7-10' water column manifold pressure.
- B. Burner shall be equipped with electronic or spark ignition, flame sensor, manual shut-off, and A.G.A approved controls.
- C. The induced draft blower shall pre-purge and shall be provided with a proving switch to prevent burner operation if blower is not in operation.
- D. Units shall be equipped with modulating gas valves with turndown ratios as listed in the schedule on the drawings.
- E. A.G.A. thermal efficiency for the heat exchanger shall be minimum of 80 percent.
- F. Manual reset limit switch shall shutdown the burner in case operating controls fail.

2.11 DAMPERS

- A. Provide Class 2 low leakage dampers with airfoil blades, rated at 1" inches W.C. static pressure.
- B. Leakage rate shall be determined in accordance with AMCA Standard 500.

2.12 ELECTRICAL REQUIREMENTS

- A. The unit shall be designed for the electrical service designated on the drawings.
- B. Arrange electrical cabinet for connecting electrical service at one point only.
- C. Power and control wiring of the unit shall be factory installed complete within the unit. Provide correctly identified suitable lugs and terminal strips for field connection to electrical power and external controls.

- D. Factory equip unit with motor starters for each of the motor driven components.
- E. Factory equip with unit mounted variable frequency drives (VFD) or ECM motors located inside the unit cabinet. VFD's shall be completely pre-wired and ready for operation.

2.13 CONTROLS (CONSTANT VOLUME UNITS)

- A. Integrated Modular Control (IMC)
 - 1. Solid state control board to operate unit.
 - 2. Built-in functions include:
 - a. Blower on/off delay
 - b. Built-in control parameter defaults
 - c. Service relay output
 - d. Dirty filter switch input
 - e. Humidity control input
 - f. Single differential economizer control
 - g. Gas valve delay between stages
 - h. Unit diagnosis with code storage
 - i. CO2 level input
 - j. Low ambient controls
 - k. Minimum run time
 - l. Night setback mode
 - m. Smoke alarm mode
 - n. Low pressure control
 - o. Three (3)-digit display
 - p. Degrees F or degrees C display
 - q. Heating and cooling staging
- B. Provide wall mounted thermostat with back lit digital display. At a minimum thermostat shall be capable of setpoint adjustment, 5-1-1 day programming, unoccupied setback, and filter status. Thermostat may use pushbutton or touchscreen interface. Thermostat shall be manufactured by unit manufacturer or Honeywell.
- C. Gas Heating Controls
 - 1. Modulating heating control
 - 2. Supply fan to turn on after heating demand is received with an adjustable time delay.
 - 3. Supply fan to turn off after heating demand has ended with an adjustable time delay.
 - 4. Adjustable delay time between low and high fire of gas valve system.
 - 5. To turn off heat if induced airflow is too low.
 - 6. Error reported if gas valve not energized two (2) minutes after heating demand.
 - 7. Shut off gas valve if flame not sensed.
 - 8. Delay between stages on gas valve.
 - 9. To shut off unit if gas valve is energized with no demand for heat.

10. All errors reported.

D. Cooling Controls

1. Automatic outside air dampers for fixed outside air quantity. Remote controlled outside air dampers with damper operator and means for adjusting outside air quantity. Motorized outside, and Power exhaust relief dampers with spring return damper operator and control package to automatically vary outside air quantity. Outside air and exhaust air dampers, normally closed. Tight-fitting parallel blade dampers with neoprene or suitable gaskets, synthetic bushings and 1% maximum leakage. Damper Operation: 24 V, spring return motor with gear train sealed in oil. Mixed Air Controls: Maintain 55° F mixed air temperature (adjustable) Variable speed compressors for modulating cooling control
2. Adjustable blow on and off delay
3. Minimum compressor on time of five (5) minutes, adjustable between 1-8 minutes.
4. Maximum high and low pressure switch.

F. Condenser Fan Control: On units with multiple condenser fans, adjustable time delay between condenser fan shutoff and restart to prevent reverse rotation of fan.

G. The microprocessor controller provided by the equipment manufacturer shall be capable of receiving signals from a variety of control sources, which are not mutually exclusive. The control shall interface with the building automation system (BAS) via the BACNet interface panel. All variables listed in the points list shall be passed to the BAS via the gateway. Application specific controllers (ASC) shall communicate using protocol specified above. Equipment manufacturer shall include on-site programming assistance to both the Owner and BAS provider to: Assure that data from their respective interface is available. Assist the BAS Provider to establish proper communication. Confirm that the interface and controller are operating in accordance with sequence of operation. Provide software or hardware tools as required to operate and checkout the controller interface. Insulate all surfaces expected to be at or below a dew point temperature of 78° F to prevent condensation. **ACCESSORIES**

A. Roof Curb

1. Furnish one (1) complete roof curb for each packaged unit, designed for weatherproof installation. Curb shall be furnished approved by unit manufacturer.
2. Supply and return ducts shall connect through the curbed opening with flexible connections to the bottom of the A/C unit, unless shown otherwise on the drawings.
3. Curb shall comply with National Roofing Contractors Association requirements.
4. Slope of roof curb shall match roof slope to provide for level support of packaged unit.
5. Contractor shall be responsible for coordination of curb, supply and return ducts, and weatherproofing of the entire installation.

B. Outside air intake assembly, including low-leak dampers, weather hood and motorized open/closed actuators.

C. Units shall be equipped with economizer. Economizers shall include a fully modulating 100 percent outside air damper that is mechanically interlocked with a return air damper.

- D. Where designated on the drawings, units shall be equipped with a powered exhaust fan and necessary controls to prevent pressurization of the building during economizer operation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state, and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.
- C. Gas packaged air conditioning units shall be installed according to manufacturer's recommendations to be completely weatherproof. Protect the roof from damage during installation. Secure factory touch-up paint to repair scratches and minor damage to equipment prior to Start-up.
- D. Power wiring to the units, including externally mounted service disconnect switch, shall be furnished and installed under Division 26. Installing Contractor shall be provided with the manufacturer's Shop Drawings as required for power wiring installation.
- E. Controls for conditioned spaces shall be as required under Division 23, Building Automation System.

3.2 TESTING

- A. Equipment shall be cycled through all heating, cooling, and ventilation cycles to ensure proper operation of all components and controls prior to test and balance.
- B. At time of Start-up, manufacturer's representative shall visit the Project site and verify that unit installation and performance is satisfactory, and to make any adjustments or settings to unit operating and safety controls that may be required.
- C. Include Start-up checkout service of at least one (1) working day for one (1) service technician, including a written report of operational check provided to the owner. Owner's Representative may require that the Start-up service be performed with Owner's attendance and on-site review.
- D. Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- E. Clean filters shall be placed within the unit the time of Substantial Completion.

END OF SECTION

SECTION 23 7423 – MAKEUP AIR UNIT

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the makeup-air unit(s) indicated by the Contract Documents with supplementary items necessary for proper installation.

1.2 REFERENCES

- A. The adopted version of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. ANSI Standard Z83.8 (adopted version)/CSA 2.6 (adopted version) and shall bear the ETL label.
 - 2. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
 - 3. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
 - 4. AMCA 99 - Standards Handbook.
 - 5. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
 - 6. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
 - 7. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.
 - 8. AMCA 500 - Test Methods for Louver, Dampers, and Shutters.
 - 9. ARI 260 - Sound Rating of Ducted Air Moving and Conditioning Equipment
 - 10. NEMA MG1 - Motors and Generators.
 - 11. NFPA 70 - National Electrical Code.
 - 12. NFPA 90A – Flame and Smoke Spread Ratings.
 - 13. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
 - 14. UL 900 - Test Performance of Air Filter Units.
 - 15. ANSI/ASHRAE/IESNA Standard 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings

1.3 SUBMITTALS

- A. Product Data
 - 1. Catalog sheets, brochures, performance charts, standard schematic drawings, specifications and installation instructions for each air handling unit.
- B. Contract Closeout Submittals
 - 1. Operation and Maintenance Data as required in Section 230500.
- C. The supplier shall furnish gas piping schematics, as built wiring connection and control-circuit diagrams, dimension sheets and a full description of the unit(s). Service manuals, showing service and maintenance requirements, shall be provided with each unit.

1.4 QUALITY ASSURANCE

- A. Unit(s) shall be operated, tested and set at the factory using job-site conditions for electrical and gas input. All operating and safety controls shall be tested and set at the factory. Adjustable or fixed sheaves shall be set for proper RPM at specified conditions. Gas-pressure regulator shall be set for specified burning rate at specified inlet pressure.

1.5 WARRANTY

- A. Units shall be furnished with full coverage warranty against defects in materials. Warranty on the complete unit shall be for one (1) year from the Substantial Completion date.
- B. Component Warranties from date of Substantial Completion
 - 1. Compressors: five (5) years
 - 2. Controls: three (3) years
 - 3. Heat Exchangers: ten (10) years

PART 2 - PRODUCTS

2.1 GAS FIRED MAKEUP – AIR UNITS

- A. Acceptable Manufacturers
 - 1. AbsolutAire
 - 2. Airedale
 - 3. CaptiveAire
 - 4. Greenheck
 - 5. Rupp
 - 6. ThermoTek

7. Trane
 8. Hartzell
 9. Bananza
 10. Ares
- B. Modular Packaged Heating and ventilating units, as indicated on the drawings shall be furnished.
- C. Unit(s) shall be Direct Fired Gas, down discharge. Units shall be factory assembled, tested and shipped as a complete packaged assembly, for outdoor mounting.
- D. Makeup-air units shall consist of the following components
1. Gas burner
 2. DX cooling with unit mounted compressors / condensing units
 3. Supply fan, motor and drive assembly. Integral variable frequency drive to allow for fan speed modulation
 4. Filters
 5. Outside air intake hood, bird screen, insect screen, modulating damper and actuators
 6. Roof curb
 7. Access doors
 8. Stand alone controls with interface to the kitchen hood control system to operate the unit in conjunction with the hoods and exhaust fans. Unit will also include an interface with the building automation system for unit monitoring.
 9. Single-point electrical connection and safety controls
 10. Remote control panel
- E. Housing
1. Exterior metal panels to be G-90 galvanized steel or aluminum, 18 gauge minimum. Painted with high grade exterior finish, color selection by Architect. Assume color shall be white, off-white, or light tan for bidding purposes.
 2. All interior surfaces to be lined with 1" thick, 1-1/2 pound density foil-face fiberglass insulation.
 3. Floor and wall panels shall be caulked air tight with a silicone caulk. All casing panels shall be attached with sheet metal screws or rivets, which can be removed to field service large components.
 4. The unit base shall be suitable for curb.
 5. Housing construction should be suitable for outdoor installation

6. An observation port shall be located on the exterior of the unit for observation of the main flame and pilot flame.
7. All controls, gas valves, modulating controls and electrical components shall be mounted within the burner vestibule. The burner vestibule shall be an integral part of the unit and not extend outside the exterior casing of the unit and not exposed to the main air stream. The vestibule full-size door shall provide easy access to controls and gas-train components. Blower door shall provide easy access to blower, motor and drives.
8. Access doors shall be provided on both sides of unit providing full access to every part of the unit.

F. Base

1. The base shall be constructed of galvanized steel for improved rigidity. Base shall be structurally reinforced to accommodate the blower assembly and burner.

G. Blowers

1. Blower(s) shall be forward-curved, centrifugal, Class I or II, double width, double inlet, constructed G-90 galvanized steel.
2. Unit shall have a heavy-duty, solid-steel shaft. Wheels shall be balanced in two planes and done in accordance with AMCA standard 204-96, Balance Quality and Vibration Levels for Fans. The wheel blades shall be aerodynamically designed to minimize turbulence, increase efficiency and reduce noise. The wheel blades shall be securely attached to the wheel inlet ring. The wheel shall be firmly attached to the fan shaft with setscrews and keys
3. The blower assembly shall be isolated from the fan structure with vibrations isolators and flexible duct connections on discharge.

H. Motors

1. Motors shall be heavy-duty ball bearing type and furnished at the specified voltage, phase and enclosure. Motor mounting plate shall be constructed of heavy gauge galvanized steel and shall be designed to provide easy adjustment of the belt tension. Must meet all requirements of Section 230513.

I. Shafts

1. Shall be precision ground and polished. Heavy duty, pre-lubricated bearings shall be selected for a minimum (L50) life in excess of 200,000 hours of operation at maximum cataloged operating speed. They shall be designed for, and individually tested, specifically for use in air handling applications

J. Belts and Drives

1. Shall be oil and heat resistant, non-static, grip-notch type. Drives shall be cast type, precision machined and keyed, and secured attached to the fan and motor shafts.
2. Fan operating speed shall be factory set using adjustable pitch motor pulleys. All drives shall be a minimum of two (2) grooves above 2 HP

K. Gas Train

1. All gas equipment should conform to local code requirements. All gas manifold components shall be piped and wired at the factory.
2. Components to include:
 - a. Pilot-gas shut-off valve
 - b. Pilot-gas regulator
 - c. Pilot-gas valve
 - d. Main-gas shut-off valve
 - e. Main-gas regulator
 - f. Two (2) solenoid valves
 - g. Modulating-gas valve
 - h. Burner
 - i. Safety Controls
 - j. Motor starter with adjustable overloads
 - k. Air-flow safety switch
 - l. Electronic flame-safety relay
 - m. High-temperature limit switch
 - n. Main-gas regulator
 - o. Two (2) safety shutoff valves
 - p. Modulating-gas valve
 - q. Adjustable burner ON/Off inlet air duct-stat to shut off burner when inlet air is sufficiently warm to maintain space temperature.
 - r. Non-fused disconnect
 - s. Accessories

L. Packaged DX Cooling

1. Unit to be provided with a fully operational, integrated DX cooling system that is factory installed and tested. Shall include but not be limited to the following components:
 - a. Compressor(s)
 - b. Evaporator and Condenser Coil(s)
 - c. Condenser Fans
 - d. Controls
2. Refrigeration Components
 - a. Coil shall be constructed of copper tubing, permanently bonded to aluminum fins and enclosed in a galvanized steel frame.
 - b. Units with multiple coils shall be interlaced.
 - c. Unit to be R-454B or R-32 fully charged from the factory
 - d. Unit mounted condensing units with factory piping, power and controls.
 - e. Factory installed refrigerant leak detection system.
 - f. All piping to be insulated
3. Drain Pan
 - a. Provide with an integral, stainless steel, double pitched, drain pan that terminates on the unit exterior.

M. Outlet Dampers

1. Manufacturer shall provide and install on unit, when possible, a two-position, motor-operated damper with internal end switch to energize the blower-starter circuit, when damper is 80% open.

2. Blades shall be a maximum of 6" wide 16-gauge G-90 galvanized steel and shall be made to guarantee the absence of noticeable vibration at design air velocities.
3. Damper blades are to be mounted on friction-free synthetic bearings. Damper edges shall have PVC coated polyester fabric mechanically locked into blade edge. Jamb seals used are flexible metal, compression type.

N. Filters

1. The filters shall be (2") thick, aluminum mesh coated with super-filter adhesive, aluminum mesh with polyester foam or pleated throw away.
2. Aluminum-mesh filters shall have aluminum frames with media to be layers of split and expanded aluminum, varying in pattern to obtain maximum depth loading. Washable 2" filters shall be enclosed in two-piece, die-cut frame with diagonal supports.
3. Frame shall be constructed of heavy-duty beverage board. Filter media is supported on the air leaving side by a metal grid.

O. Filter Section

1. Shall be either insulated or non-insulated constructed of G-90 galvanized steel with filters supported by internal slides and with removable access panels.
2. Fresh-air inlet hood: Shall be constructed of G-90 galvanized steel with bird screen. Hood to prevent the intake of moisture and snow at normal operating conditions. Maximum filter face velocity of 400 ppm.

P. Electrical and Wiring

1. A single point electrical connection shall be supplied. The control circuit voltage shall be 115 volts. A control transformer shall be provided, when required.
2. Wiring in control enclosures shall be in accordance with the National Electrical Code and the local code, as it may affect the installation. Motor starter and variable frequency drive shall be provided.
3. Unit(s) shall be complete with all items such as relays, starters, switches, safety controls, conduit and wire as previously mentioned, and as required for proper operation.
4. All factory-mounted controls shall be factory pre-wired to the unit control panel. A safety disconnect switch shall be standard on all units and shall be sized according to the unit.
5. Provide with a powered GFCI duplex receptacle with weathertight hinged cover. Outlet shall not require a separate power connection.

Q. Unit Controls – Kitchen Hood Makeup

1. For kitchen hood exhaust-air replacement with supply air temperature control. A fixed discharge setpoint for heating and cooling will control the gas heating coil and DX cooling system capacities.
2. High- and low-discharge air sensor probes limit maximum and minimum discharge-air temperatures.

3. Makeup air unit airflow will vary based on the exhaust fan airflow based. A signal received from the kitchen hood control panel will adjust the supply airflow from the makeup air unit.
4. Unit manufacturer to include a remote-control panel to enable / disable unit and change operating mode.

R. Unit Controls – Space Temperature Control

1. For building exhaust-air replacement with modulated space- temperature control. A modulating space thermostat adjusts burner flame to maintain discharge-air temperature to compensate for changing building heat losses or gains. High- and low-discharge air sensor probes limit maximum and minimum discharge-air temperatures. Include a SUMMER- OFF/WINTER selector switch and exhaust-system interlocks control heater-blower operation. Supplied with remote-control panel with SUMMER-OFF/WINTER selector switch and a modulating-room thermostat.

S. Unit Controls – Space Pressure Control

1. A factory-supplied field wired VFD is provided which varies the speed of the blower wheel. A field wired Static Pressure Controller, which measures building pressure and closes and opens contacts on the VFD to accelerate or decelerate the blower speed to maintain the building pressure set on the Static Pressure Controller, controls the VFD. Fan speed will modulate down to 20%. Factory supplied automatic profiles maintain the burner profile pressure drop as the blower speed is varied.
2. See Section 232923 for complete VFD requirements. All VFD's on the project shall be the same, no exceptions. Coordinate with VFD supplier.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the Work of this Section in accordance with the manufacturer's printed instructions.
- B. During construction provide temporary closures of metal or taped polyethylene over openings into housing ducts to prevent dust from entering ductwork.
- C. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION

SECTION 23 8200 – TERMINAL HEATING EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all work required to provide and install the following Terminal Heating Devices indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Equipment Included in This Section
 - 1. Electric Terminal Heat
 - a. Unit Heaters
 - b. Cabinet Unit Heaters

1.2 SUBMITTALS

- A. Product Data: Catalog cuts, specifications, installation and maintenance instructions for each type of heater specified.
- B. Schedule: List manufacturer, unit type, model number, and performance data for each unit heater.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements: Heaters shall be UL listed.
- B. Certification: Affidavit from finned tube radiation manufacturer certifying that element has been tested in accordance with the requirements of IBR Testing and Rating Standard for finned tube radiation.

1.4 MAINTENANCE

- A. Special Tools: One (1) tool for each type and size vandal resistant fastener.

PART 2 - PRODUCTS

2.1 CONFIGURATION AND PERFORMANCE

- A. Refer to the equipment schedules for additional configuration and performance requirements.

2.2 ELECTRIC TERMINAL HEAT

- A. Electric Unit Heaters
 - 1. Acceptable Manufacturers
 - a. Berko
 - b. Brasch

- c. Indeeco
 - d. King Electric
 - e. Markel
 - f. Modine
 - g. Q-Mark
 - h. Raywall
 - i. Redd-I
 - j. Stelpro
 - k. Trane
 - l. TPI Corp
2. Unit Casing: Constructed of steel sheet formed, reinforced, and braced for rigidity, with steel louvers or deflectors with sufficient rigidity to prevent vibration at all fan speeds.
 - a. Materials:
 - 1) Galvanized Steel Sheet: ASTM A 653, coating designation G90.
 - 2) Cold-Rolled Steel Sheet: ASTM A 366, cleaned, degreased and phosphatized.
 - b. Factory Finish: Minimum two (2) coat baked enamel finish on exposed surfaces, color as directed.
 3. Provide with discharge nozzle for units to throw air from the specified mounting height to the floor or as specified on the drawings. At a minimum, units shall include the following:
 - a. Horizontal Delivery Units: Adjustable horizontal and vertical louvers.
 - b. Vertical Delivery Units: Louvered deflector mounted outside fan orifice.
 4. Provide all necessary mounting hardware to support the heater.
 5. Electric-Resistance Heating Elements: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550° F at any point during normal operation.
 6. Circuit Protection: One (1)-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.
 7. Wiring Terminations: Stainless-steel or corrosion-resistant material.
 8. Fan Assembly (Refer to schedule for fan type)
 - a. Fan (Propeller): Multiple blade propeller type, statically and dynamically balanced, and directly connected to electric motor.
 - b. Fan (Blower): Double width, double inlet (DWDI), forward curved, belt driven, assembly with spider ball bearings.
 9. Motor: Single phase, totally enclosed electric motor of the permanent split capacitor or shaded pole type, with resilient mounting, terminal box for wiring connections, built-in overload protection, and ball or sleeve bearings with oilers, or permanently lubricated bearings.
 10. Refer to schedule for control type and electrical requirements for the unit.

B. Electric Cabinet Unit Heaters

1. Acceptable Manufacturers

- a. Berko
 - b. Brasch
 - c. Indeeco
 - d. King Electric
 - e. Markel
 - f. Q-Mark
 - g. Raywall
 - h. Redd-I
 - i. Stelpro
 - j. Trane
 - k. TPI Corp
2. Unit Casing: Constructed of steel sheet formed, reinforced and braced for rigidity, with stamped grilles.
 - a. Materials:
 - 1) Galvanized Steel Sheet: ASTM A 653, coating designation G90.
 - 2) Cold-Rolled Steel Sheet: ASTM A 366, cleaned, degreased and phosphatized.
 - b. Factory Finish: Minimum two (2) coat baked enamel finish on exposed surfaces, color as directed.
 - c. Insulation: Insulate interior surfaces of casing panels with 1/2 inch glass fiber meeting NFPA 90A requirements.
 - d. Vertical Units: Minimum 18 gauge construction with removable front panel.
 - e. Horizontal Units: Minimum 18 gauge construction with hinged bottom panel.
 3. Electric-Resistance Heating Elements: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550° F at any point during normal operation.
 - a. Circuit Protection: One (1)-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.
 - b. Wiring Terminations: Stainless-steel or corrosion-resistant material.
 4. Fan Assembly: Blow thru design.
 - a. Fans: Forward curved centrifugal type, double width, statically and dynamically balanced, and directly connected to electric motor.
 5. Motors: Three (3) speed, single phase electric motors of the permanent split capacitor or shaded pole type, with resilient mounting, built-in overload protection with automatic reset, and ball or sleeve bearings with accessible oilers, or permanently lubricated bearings.
 6. Filter Section: Built-in filter frame mounted at air inlet with disposable air filters.
 - a. Vertical Units: Filters removable without removing front panel for cabinet type units.
 - b. Horizontal Units: Filters removed by pivoting hinged bottom panel.
 7. Refer to schedule for cabinet style, control type and electrical requirements for the unit.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the Work of this section in accordance with the manufacturer's printed installation instructions, unless otherwise specified.

END OF SECTION

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SECTION 26 0500 – COMMON WORK RESULTS

PART 1 - GENERAL

1.1 SCOPE

- A. The work under this section includes basic electrical requirements, which are applicable to all Division 26, 27 and 28 sections.
- B. Overview of Work
 - 1. Demolition/Relocation/Modification
 - 2. Power Distribution
 - 3. Branch Power
 - 4. Equipment Connections
 - 5. Lighting and Lighting Controls
 - 6. Low Voltage Systems (such as: fire alarm, etc.)
- C. In these documents, "Contractor" refers to the Electrical Contractor and all their subcontractors, unless listed otherwise. The division of Work with the electrical scope is the responsibility of the lead Electrical Contractor General Contractor.
- D. The Contractor is responsible for providing and installing fully functional systems.
- E. If the Work is shown on the drawings or noted in the specifications, it shall be included by the Contractor.
- F. If equipment is provided by the Contractor, it shall be installed by the Contractor, unless noted otherwise.
- G. Drawings are necessarily diagrammatic by their nature and are not intended to show every connection in detail or every conduit in its exact location. Carefully investigate structural and finish conditions and coordinate the separate trades in order to avoid interference between the various phases of Work. Organize and lay out Work so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. Install all Work parallel or perpendicular to building lines unless otherwise noted.
- H. The intent of the Drawings is to establish the types of systems and functions; not to set forth each item essential to the functioning of the system. Install the Work complete, including minor details necessary to perform the function indicated. Review pertinent Drawings and adjust the Work to conditions shown. Where discrepancies occur between Drawings, Specifications, and actual field conditions, immediately notify the Architect and Engineer for interpretations.
- I. All sizes as given are minimum except as noted.
- J. All materials shall be new (unless noted or stated otherwise) and free of defect.

- K. All work shall be subject to the Architect's, Engineer's, and Owner's observations from the commencement of work until the acceptance of the completed work.

1.2 RELATED WORK

- A. Applicable provisions of Division 0 and Division 1 govern work under this Section.

1.3 REFERENCES

- A. All work shall conform to the most current version of all applicable codes and standards or the version adopted by the jurisdiction.
- B. Codes
 - 1. International Building Code
 - 2. International Fire Protection Code
 - 3. International Energy Conservation Code
 - 4. NFPA – National Fire Protection Association
 - a. NFPA 70 (National Electric Code)
 - b. NFPA 72 (National Fire Alarm and Signaling Code)
 - c. NFPA 101 (Life Safety Code)
 - 5. State or City Codes for the City of Colfax, IA
- C. Standards
 - 1. ANSI
- D. Governing Bodies
 - 1. Owner's Insurance Company
 - 2. State Fire Marshall
 - 3. AHJ – Authority Having Jurisdiction
 - 4. UL - Underwriters Laboratories

1.4 SUBMITTALS

- A. The review of Shop Drawings by the Engineer is for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Corrections or comments made on the shop drawings during this review do not relieve the contractor from compliance with the requirements of the Plans and Specifications. Approval of a specific item shall not include approval of an assembly of which the item is a component. The Contractor is responsible for: dimensions to be confirmed and correlated at the jobsite; information that pertains solely to the fabrication processes or to the means, methods, techniques, sequences and procedures of construction; coordination with the Work of all trades; and for performing all work in a safe and satisfactory manner.

1. Manufacturer or contractor compliance letter for compliance with the “Build America, Buy America Act” (BABAA). Include the following:
 - a. Company Name
 - b. Company address
 - c. Project name
 - d. Statement of compliance with the BABAA requirements
 - e. List of items, projects, and/or materials specific to the project that the submitted letter includes.
 - f. Location of manufacturing processes
 - g. Authorized company or contractor signature
 - h. Date
- B. Refer to individual technical Specification sections for specific submittal requirements.
- C. Submission of Shop Drawings electronically in .PDF format is required.
- D. If hard copies of shop drawings are required for this project, coordinate the quantity with the Architect and General Contractor. Provide one (1) copy for the Engineer’s records.
- E. The Engineer will review one (1) resubmittal for each product. If additional resubmittals are required, the Contractor shall be responsible to bear the cost for the Engineer to recheck and handle the additional shop drawing submittals. Documents will not be reviewed until payment is agreed upon.
- F. Contractor may request electronic files from the Engineer if needed to complete their Shop Drawings. An Electronic File Request Form will be sent to the contractor if files are requested and must be completed and signed before the AutoCAD files are released to the Contractor.
- G. All submittals for equipment and materials shall be reviewed and approved by the Engineer prior to the fabrication or release by the contractor. This includes the coordination of equipment between trades. The release, purchase, installation or fabrication of any items prior to the contractor receiving an approved shop drawing will be at the contractor’s own risk. Any rework that results will be provided by the contractor at no cost to the Owner or design team.
- H. Submittals must be reviewed and approved by the Contractor before submitting to the Engineer.
- I. Submittals shall be grouped to include complete submittals of related systems, products, and accessories in a single submittal. Mark dimensions and values in units to match those specified. Include wiring diagrams of electrically powered equipment.

1.5 ELECTRONIC DOCUMENT RELEASE

- A. Electronic versions of the bid documents will be made available to the contractors for use during the bidding process and to help generate fabrication drawings for various systems. A summary of the requirements for the various document types is listed below:
 1. PDF
 - a. Contact the Construction Manager or Architect to obtain a PDF version of the Bid Documents. No Document Release Form is required.
 2. AutoCAD
 - a. KEDbluestone Engineering can provide an AutoCAD version of the bid documents for the contractor to use for generating shop drawings and fabrication drawings.

This will include plan drawings with the architectural background. The contractor is responsible for incorporating any modifications that occur during bidding by all disciplines. Details and schedules will not be included.

- b. A document release form (see attached) will be required to be completed by the contractor to determine the version of AutoCad and drawings required. No fee is associated with these drawings.

1.6 SUBSTITUTIONS

- A. All manufacturers listed as Acceptable Manufacturers in each specification section are considered equal to the basis of design. The basis of design is preferred and will take precedence. Any products from an alternate approved manufacturer need to meet the requirements and performance specified and shall be equal to the basis of design.
- B. The Contractor may request permission for a substitution of any item (equipment or material), subject to the following conditions:
 - 1. Submit substitution requests in writing to the Engineer, on a form supplied by the Engineer. A sample copy of this form is included at the end of this section. An electronic copy can also be provided to the Contractor by the Engineer.
 - 2. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contractor documents, the Contractor is responsible for all costs involved in integrating the equipment or accessories into the system and the assigned space and for obtaining the performance from the system into which these items are placed as well as any re-design costs incurred by the Architect or Engineer. The Contractor is also responsible for coordinating changes required by other trades.
 - 3. Any requests for alternate manufacturers must be submitted to the Architect/Engineer at least ten (10) days prior to bid day. Incomplete substitution requests will not be considered.
- C. Approval
 - 1. No work involving requests for substitution shall commence without written approval on the provided form by the Engineer.
 - 2. Any work started or material ordered/installed by the Contractor without written approval shall be removed/repared at the sole expense of the contractor. The Contractor will also be responsible for any costs incurred by the Owner for such rework.

1.7 QUALITY ASSURANCE

- A. Build America, Buy America: All equipment and infrastructure shall comply with the federal "Build America, Buy America Act" (BABAA) (Title IX of the Infrastructure Investment and Jobs Act of 2021 [Pub.L. 117-58, §§ 70901-70953] domestic preference requirements for iron and steel, manufactured products, and construction materials. Manufactured products shall be produced or manufactured in the U.S. and the percentage of costs of manufactured components mined, produced, or manufactured in the U.S. shall meet the current federal standard of 55%. Manufacturers that do not comply with BABAA will need approved waivers from the federal government on the basis of "domestic non-availability, unreasonable cost, or public interest" prior to the execution of contracts or purchase orders.

B. Warranty

1. Equipment warranty shall be a minimum of one (1) year from date of factory supervised startup or from the date of substantial completion, whichever is later.
2. Contractor shall warranty all of their work for one (1) year from the date of substantial completion

C. These documents are diagrammatical in nature and intended to convey scope and general arrangement of the electrical and technology systems. Not all conduits, junction boxes, accessories, etc. are shown on Plan. If items are required to make a system fully operational but not shown on Plan or in these Specifications, they shall be included by the Contractor.

D. The intent of the Drawings is to establish the types of systems and functions; not to set forth each item essential to the functioning of the system. Install the Work complete, including minor details necessary to perform the function indicated. Review pertinent Drawings and adjust the Work to conditions shown. Where discrepancies occur between Drawings, Specifications, and actual field conditions, immediately notify the Architect and Engineer for interpretations.

E. It is the contractor's responsibility to determine all utility routing prior to purchase and installation of material.

F. For remodel or addition projects, the contractor shall visit and survey the site prior to submitting a bid. The contractor shall visit the site to understand the complexity of utility routing, phasing, staging, and all general installation. Submitting a bid means the contractor acknowledges the complexities of the project and has made provisions for overcoming these complexities in their bid.

G. The Contractor shall report any discrepancies between these documents and site conditions immediately to the Engineer prior to submitting a bid or starting work. Submittal of a bid indicates that the contractor and the contractor's subcontractors have carefully and thoroughly reviewed the Drawings, Specifications, and other construction documents and have found them complete and free from ambiguities and sufficient for the purposes intended.

H. Install all equipment per the manufacturer's requirements / recommendations.

I. No equipment provided or installed shall contain mercury.

J. Manufacturer / Supplier Inspection & Startup

1. The following equipment shall have a factory representative perform start-up. The procedure shall be documented and submitted to the design team and Owner. Include copies of startup reports in the Operations & Maintenance Manuals.
 - a. Lighting Control Systems, including occupancy sensor controls

K. All equipment shall be UL listed where applicable.

1.8 REGULATORY AND UTILITY REQUIREMENTS

A. Contractor is responsible for coordinating all required site inspections by authorities having jurisdiction. Contractor shall notify **General Contractor** of all scheduled inspections seven (7) working days prior to site visit.

B. Contractor is responsible for paying for all fees, permits, and inspections that are required to complete their work.

- C. Contractor shall include all work required to **install new** utilities and meters as shown on drawings.

1.9 PROTECTION OF FINISHED SURFACES

- A. Furnish one (1) can of touch-up paint for each different color factory finish for equipment furnished by the Contractor. Deliver touch-up paint with other "loose and detachable parts" as covered in the General Requirements.

1.10 SEALING AND FIRESTOPPING

- A. Sealing and firestopping of sleeves/openings between conduits, cable trays, wireways, troughs, etc. and the structural or partition opening shall be the responsibility of the **contractor whose work penetrates the opening** General Contractor. The contractor responsible shall hire individuals skilled in such work to do the sealing and firestopping. These individuals hired shall normally and routinely be employed in the sealing and fireproofing occupation.

1.11 OMISSIONS

- A. No later than ten (10) days before bid opening, the Contractor shall call the attention of the Architect and Engineer to any materials or apparatus the Contractor believes to be inadequate and to any necessary items of work omitted.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. All equipment and materials shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.
- B. Store equipment indoors in clean dry space with uniform temperature to prevent condensation. Equipment shall include but not be limited to panelboards, **uninterruptible power systems**, enclosures, controllers, circuit protective devices, cables, wire, light fixtures, electronic equipment, and accessories.
- C. During installation, equipment shall be protected against entry of foreign matter; and be vacuum-cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.
- D. Take such precautions as are necessary to protect apparatus and materials from damage. Damaged equipment shall be, as determined by the Owner and/or Engineer, placed in first class operating condition or be returned to the source of supply for repair or replacement.
- E. Protect factory finish from damage during construction operations until acceptance of the Project. Restore any finishes that become stained or damaged to Owner's satisfaction.

1.13 DIVISION OF WORK AND COORDINATION

- A. The Electrical Contractor is responsible for providing and installing power wiring up to equipment provided by others for a single point connection. Internal wiring of equipment provided by others shall be the responsibility of the manufacturer or the contractor responsible for providing and installing the equipment.

- B. Controls, disconnect switches, starters, variable frequency drives, etc. shall be provided and installed by the contractor noted on the plans and in the specifications. It is the responsibility of the Contractor to request written clarification for any ambiguity regarding division of work and coordination at least ten (10) days prior to bid.
- C. Utilities routed within the building shall be installed in an orderly manner. All work will be coordinated with other disciplines prior to installation. The following list ranks the priority of the utilities to be installed:
 - 1. Light fixtures
 - 2. Gravity piping
 - 3. Ductwork
 - 4. Cable tray
 - 5. All other piping
 - 6. Electrical conduits
- D. Any installed work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.
- E. Coordinate work with the Testing and Balancing (TAB) Contractor. Verify system completion to the TAB Contractor such as fire/smoke damper integration ready for testing, power provided to control panels and control devices as specified, and power provided to all equipment and dampers that are required to operate for testing and balancing. Assist the TAB Contractor as needed to complete their work.
- F. Arrange for conduit and raceway spaces, chases, slots, and openings in building structure during progress of construction, to allow for electrical installations.
- G. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- H. Coordinate requirements for access panels and doors for electrical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.14 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.
- B. In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation as applicable:
 - 1. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
 - 2. A control sequence describing start-up, operation, and shutdown.
 - 3. Description of the function of each principal item of equipment.

4. Installation instructions.
5. Safety precautions for operation and maintenance.
6. Diagrams and illustrations.
7. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers and replacement frequencies.
8. Performance data.
9. Where applicable, pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
10. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.

1.15 RECORD DRAWINGS

- A. The Contractor shall maintain at least one (1) copy of the Specifications and Drawings on the job site at all times.
- B. The Architect will provide the Contractor with a suitable set of Contract Drawings on which daily records of changes and deviations from contract shall be recorded. Dimensions and elevations on the record drawings shall locate all buried or concealed piping, conduit, or similar items.
- C. The daily record of changes shall be the responsibility of Contractor's field superintendent. No arbitrary mark-ups will be permitted.
- D. At completion of the project, the Contractor shall submit the marked-up record drawings to the General Contractor prior to final payment.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Conditions: Provide new products of manufacturers regularly engaged in production of such equipment. Provide the manufacturer's latest standard design for the type of product specified.
- B. Space Limitations: Equipment selected shall conform to the building features and shall be coordinated with all components. Do not provide equipment that will not meet arrangement and space limitations.
- C. Common Source: Equipment specified in Sections 262416 Panelboards, 262728 Disconnect Switches, 262730 Contactors, 262816 Enclosed Switches and Circuit Breakers shall be provided by the same manufacturer.

2.2 ACCESS PANELS AND DOORS

- A. Provide access panels and/or doors where required to maintain access to the electrical installation and where noted on the Drawings.
- B. Lay-in Ceilings
 - 1. Removable lay-in ceiling tiles in 2 x 2 foot or 2 x 4 foot configuration provided under other divisions are sufficient; no additional access provisions are required unless specifically indicated.
- C. Plaster/Gypsum Walls and Ceilings
 - 1. 16 gauge frame with not less than a 20 gauge hinged door panel, prime coated steel for general applications, stainless steel for use in toilets, showers and similar wet areas, concealed hinges, screwdriver operated cam latch for general application, key lock for use in public areas, UL listed for use in fire rated partitions if required by the application. Use the largest size access opening possible, consistent with the space and the equipment needing service; minimum size is 12" by 12".

2.3 IDENTIFICATION

- A. See Electrical Section 260553 – Identification.

2.4 SEALING AND FIRESTOPPING

- A. Fire and/or Smoke Rated Penetrations
 - 1. Manufacturers
 - a. 3M, STI/SpecSeal, Tremco, Hilti or approved equal.
 - 2. All firestopping systems shall be by the same manufacturer.
 - 3. Submittals
 - a. Contractor shall submit product data for each firestop system. Submittals shall include product characteristics, performance and limitation criteria, test data, MSDS sheets, installation details and procedures for each method of installation applicable to this project. For non-standard conditions where no UL tested system exists, submit manufacturer's drawings for UL system with known performance for which an engineering judgement can be based upon.
 - 4. Product
 - a. Firestop systems shall be UL listed or tested by an independent testing laboratory approved by the Department of Commerce.
 - b. Use a product that has a rating not less than the rating of the wall or floor being penetrated. Reference architectural drawings for identification of fire and/or smoke rated walls and floors.
 - c. Contractor shall use firestop putty, caulk sealant, intumescent wrapstrips, intumescent firestop collars, firestop mortar or a combination of these products to provide a UL listed system for each application required for this project. Provide mineral wool backing where specified in manufacturer's application detail.

B. Non-Rated Penetrations

1. Conduit Penetrations Through Below Grade Walls

- a. In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the uninsulated conduit and the cored opening or a water-stop type wall sleeve.

2. Conduit and Cable Tray Penetrations

- a. At conduit and cable tray penetrations of non-rated interior partitions, floors and exterior walls above grade, use urethane caulk in annular space between conduit and sleeve, or the core drilled opening.

PART 3 - EXECUTION

3.1 EXCAVATION AND BACKFILL

- A. Perform all excavation and backfill work to accomplish indicated electrical systems installation in accordance with **Division 31**.

3.2 CONCRETE WORK

- A. The Division 3 Contractor will perform all cast-in-place concrete unless noted otherwise elsewhere. Provide all layout drawings, anchor bolts, metal shapes, and/or templates required to be cast into concrete or used to form concrete for the support of electrical equipment.

3.3 CUTTING AND PATCHING

- A. Refer to Division 1, General Requirements, Cutting and Patching.

3.4 BUILDING ACCESS

- A. Arrange for the necessary openings in the building to allow for admittance of all apparatus. When the building access was not previously arranged and must be provided by this Contractor, restore any opening to its original condition after the apparatus has been brought into the building.

3.5 EQUIPMENT ACCESS

- A. Install all conduit, raceways, and accessories to permit access to equipment for maintenance. Coordinate the exact location of wall and ceiling access panels and doors with the **General Contractor**, making sure that access is available for all equipment and specialties. Where access is required in plaster or drywall walls or ceilings, furnish the access doors to the **General Contractor** and reimburse the **General Contractor** for installation of those access doors.

3.6 COORDINATION

- A. The Contractor shall cooperate with other trades in locating work in a proper manner. Should it be necessary to raise or lower or move longitudinally any part of the electrical work to better fit

the general installation, such work shall be done at no extra cost provided such decision is reached prior to actual installation. The Contractor shall check location of electrical outlets with respect to other installations before installing.

- B. The Contractor shall verify that all devices are compatible for the surfaces on which they will be used. This includes, but is not limited to light fixtures, panelboards, devices, etc. and recessed or semi-recessed heating units installed in/on architectural surfaces.
- C. Coordinate all work with other contractors prior to installation. Any installed work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing Contractor's expense.
- D. Coordinate clearances in front of and above electrical distribution equipment with other trades to avoid interference issues. Maintain clearances as defined in the National Electrical Code. Pipes, ducts, etc. shall not be installed above electrical distribution equipment.
- E. Coordinate exact locations of floor boxes, furniture wall feeds, and power poles with the **Owners'** furniture vendor.

3.7 SLEEVES

- A. Pipe sleeves for conduits 6" in diameter and smaller, in new poured concrete construction, shall be schedule 40 steel pipe, plastic removable sleeve or sheet metal sleeve, all cast in place.
- B. In wet area floor penetrations, top of sleeve to be 2 inches above the adjacent floor. In existing wet area floor penetrations, core drill sleeve openings large enough to insert schedule 40 sleeve and grout the area around the sleeve. If a pipe clamp resting on the sleeve supports the pipe penetrating the sleeve, weld a collar or struts to the sleeve that will transfer weight to the existing floor structure. Wet areas for this paragraph are rooms or spaces containing air handling unit coils, converters, pumps, chillers, boilers, and similar waterside equipment.
- C. Pipe penetrations in existing concrete floors that are not in wet areas may omit the use of schedule 40 sleeve and use the core drilled opening as the sleeve.

3.8 SEALING AND FIRESTOPPING

- A. Fire and/or Smoke Penetrations
 - 1. Install approved product in accordance with the manufacturer's instructions where a raceway (i.e. cable tray, bus, cable bus, conduit, wireway, trough, etc.) penetrates a fire rated surface.
 - 2. Where firestop mortar is used to infill large fire-rated floor openings that could be required to support weight, provide permanent structural forming. Firestop mortar alone is not adequate to support any substantial weight.
- B. Non-Rated Surfaces
 - 1. When the opening is through a non-fire rated wall, floor, ceiling or roof the opening must be sealed using an approved type of material.
 - 2. Install escutcheons or floor/ceiling plates where conduit penetrates non-fire rated surfaces in occupied spaces. Occupied spaces for this paragraph include only those rooms with finished ceilings and the penetration occurs below the ceiling.

3. In exterior wall openings below grade, assemble rubber links of mechanical seal to the proper size for the conduit and tighten in place, in accordance with the manufacturer's instructions. Install so that the bolts used to tighten the seal are accessible from the interior of the building or vault.
4. At interior partitions, conduit penetrations are required to be sealed for all clean rooms, laboratories, and most hospital spaces, computer rooms, dormitory rooms, telephone/data/com rooms and similar spaces where the room pressure or odor transmission must be controlled. Apply sealant to both sides of the penetration in such a manner that the annular space between the conduit sleeve and the conduit is completely filled.

3.9 HOUSEKEEPING AND CLEAN UP

- A. The Contractor shall clean up and remove from the premises, daily, all debris and rubbish resulting from its work and shall repair all damage to new and existing equipment resulting from its work. When job is complete, this Contractor shall remove all tools, excess material and equipment, etc., from the site.

3.10 TESTING

- A. Test Conditions
 1. Place circuits and equipment into service under normal conditions, collectively and separately, as may be necessary to determine satisfactory operation. Perform specified tests in the presence of the Owner's representative(s). Furnish all instruments, wiring, equipment and personnel required for conducting tests. Demonstrate that the equipment operates in accordance with requirements of the Contract Documents. Special tests on certain items are specified hereinafter.
 2. Where specified that the testing be performed by an independent testing company, an Owner-approved National Electrical Testing Association (NETA) certified testing company shall be used. Submit copies of test reports.

3.11 OWNER TRAINING

- A. All training provided for the Owner shall comply with the format, general content requirements and submission guidelines specified under Section 019101, or 019102.
- B. Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for a minimum period of (2) hours or for the duration noted in the technical Specifications.

3.12 NFPA 70E COMPLIANCE

- A. The Electrical Contractor will be responsible for providing ARC Flash labeling for all electrical distribution equipment installed or modified as part of this contract. This includes but is not limited to: Identification of ARC Flash Boundaries, Application of Proper labels, and Identification of Proper Labels, and Identification of Proper Personal Protective Equipment.

- B. The Contractor must ensure that personnel working on the equipment while energized are qualified to do so and are wearing the appropriate ARC Flash personal protective equipment. Documentation of this training is required.
- C. The Electrical Contractor will include in his bid the cost to hire a qualified Engineer to perform the necessary ARC Flash study.

3.13 PROJECT CLOSEOUT REQUIREMENTS

- A. Final project closeout tasks
 - 1. Deliver all spare parts listed in each specification section. Deliver to Owner chosen location.
 - 2. All equipment labeled per specifications.
 - 3. All equipment cleaned and ready for use. Install new fuses in all equipment with fuses; do not use Owner's spare fuses.
- B. Contractor requirements
 - 1. Marked up drawings and specifications provided to Engineer for incorporation of as-built drawings or to serve as the as-built drawings depending on the project requirements. As-built drawings shall be clean and legible.
 - 2. Operation and Maintenance (O & M) Manuals shall include the following:
 - a. Contractor contact for warranty work
 - b. Approved shop drawings, incorporating all review comments
 - c. Warranty copies
 - d. Equipment start-up reports
 - e. Operation and maintenance instructions
 - 3. Utility Rebate Forms
 - a. Contractor shall submit completed energy rebate forms for each piece of equipment that is eligible for a rebate. Eligible equipment shall include, but not be limited to the following:
 - 1) Interior Lighting
 - 2) Exterior Lighting
 - 3) Occupancy Sensors
 - b. Contractor to complete information regarding equipment. Submit form to Owner; Owner will complete Owner's contact information and send the completed form to the utility.
- C. **Three (3)** final approved O & M Manuals shall be delivered to Owner. Each manual shall be an appropriately sized three (3) ring binder with a vinyl cover and printed spine and cover labels. Each section shall have a printed divider tab. Each section shall be listed in a table of contents at the beginning of the manual.

END OF SECTION

(ELECTRONIC DOCUMENT RELEASE FORM & SUBSTITUTION REQUEST FORMS ATTACHED)

Document Release Form

Information Requested:

Project Name:
Drawings Requested:

Media Type: (Check all that are applicable)

- | | |
|---|--|
| <input type="checkbox"/> AutoCAD DWG Files (Version ____) | <input type="checkbox"/> Adobe PDF Files |
| <input type="checkbox"/> REVIT Files (Version ____) | <input type="checkbox"/> Other |

Requesting Party:

Name:	Address 1:
Company:	Address 2:
Signature:	Email Address:
Date:	Phone #:

KEDbluestone Use:

Form Sent By:	Date:
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KEDbluestone Project #:

Data contained on these electronic files are part of our instruments of service and shall not be used by you or anyone else receiving these data through or from you for any purpose other than as a convenience in the preparation of shop drawings for the referenced project. Any other use or reuse by you or by others will be at your sole risk and without liability or legal exposure to us. You agree to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against us, our officers, directors, employees, agents or sub consultants that may arise out of or in connection with your use of the electronic files. Furthermore, you shall, to the fullest extent permitted by law, indemnify and hold us harmless against all damages, liabilities or costs, including reasonable attorneys' fees and defense costs, arising out of or resulting from your use of these electronic files. These electronic files are not construction documents. Differences may exist between these electronic files and corresponding hard-copy construction documents. We make no representation regarding the accuracy or completeness of the electronic files you receive. In the event that a conflict arises between the signed or sealed hard-copy construction documents prepared by us and the electronic files, the signed or sealed hard-copy construction documents shall govern. You are responsible for determining if any conflict exists. By your use of these electronic files, you are not relieved of your duty to fully comply with the contract documents, including, and without limitation, the need to check, confirm and coordinate all dimensions and details, take field measurements, verify field conditions and coordinate your work with that of other contractors for the project. Because information presented on the electronic files can be modified, unintentionally or otherwise, we reserve the right to remove all indicia of ownership and/or involvement from each electronic display.

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SUBSTITUTION REQUEST FORM (DURING BIDDING)

We submit for your consideration the following product instead of the specified item for the following project:

PROJECT: _____

SPEC. SECTION	SPEC. TITLE	PARAGRAPH	SPECIFIED ITEM
_____	_____	_____	_____

Proposed Substitution: _____

MANUFACTURER	TRADE NAME	MODEL NO.
_____	_____	_____

Attached data includes product description, specifications, drawings, photographs, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including Architectural and Engineering design, detailing, and construction costs caused by the substitution.

Submitted by:

Signature

Firm

_____ Telephone	_____ Email	_____ Date
--------------------	----------------	---------------

Engineer's Review and Action

- ☐ Substitution Approved
- ☐ Substitution Approved As Noted
- ☐ Substitution Rejected
- ☐ Substitution Request Received Too Late

Signed by:

_____ Date

Supporting Data Attached:

☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ Other _____

SUBSTITUTION REQUEST FORM (AFTER BIDDING)

We submit for your consideration the following product instead of the specified item for the following project:

PROJECT: _____

SPEC. SECTION	SPEC. TITLE	PARAGRAPH SPECIFIED ITEM
_____	_____	_____

Proposed Substitution: _____

MANUFACTURER	TRADE NAME	MODEL NO.
_____	_____	_____

INSTALLER	PHONE NO.
_____	_____

History: ☐ New Product ☐ 2-5 years old ☐ 5-10 years old ☐ More than 10 years old

Differences between proposed substitution and specified product: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ days

Savings to Owner for accepting substitution: \$ _____

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including Architectural and Engineering design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by:

Signature

Firm

Telephone

Email

Date

Engineer's Review and Action

- ☐ Substitution Approved
- ☐ Substitution Approved As Noted
- ☐ Substitution Rejected
- ☐ Substitution Request Received Too Late

Signed by:

Date

Supporting Data Attached:

☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ Other _____

SECTION 26 0504 – CLEANING AND TESTING

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide the required cleaning, repair, adjustment, calibration, maintenance and testing of electrical equipment, as specified herein. This applies only to new electrical and existing electrical equipment being furnished, modified, worked on or serviced by this contractor for this project.

1.2 REFERENCES

- A. Applicable provisions of Division 1 govern work under this Section.

PART 2 - PRODUCTS – (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL INSPECTION AND CLEANING OF ALL ELECTRICAL EQUIPMENT

- A. Inspect for physical damage and abnormal mechanical and electrical conditions.
- B. Any item found to be out of tolerance, or in any other way defective as a result of the required testing, shall be reported to the Engineer. Procedure for repair and/or replacement will be outlined. After appropriate corrective action is completed the item shall be re-tested.
- C. Compare equipment nameplate information with the latest single line diagram and report any discrepancies.
- D. Verify proper auxiliary device operation and indicators.
- E. Check tightness of accessible bolted electrical joints. Use torque wrench method.
- F. Make a close examination of equipment and remove any shipping brackets, insulation, packing, etc. that may not have been removed during original installation.
- G. Make a close examination of equipment and remove any dirt or other forms of debris that may have collected in existing equipment or in new equipment during installation.
- H. Clean All Equipment:
 - 1. Vacuum inside of panelboards, switchboards, transformer core and coils, horizontal and vertical busducts, MCC's, fire alarm panels, comm/data, security panel, etc.
 - 2. Loosen attached particles and vacuum them away.
 - 3. Wipe all insulators with a clean, dry, lint free rag.
 - 4. Clean insulator grooves.

5. Inspect equipment anchorage.
6. Inspect equipment and bus alignment.
7. Check all heater elements for operation and control.
8. Lubricate nonelectrical equipment per manufacturer's recommendations.

3.2 GROUNDING SYSTEMS

- A. Inspect the ground system for adequate termination at all devices.

3.3 INSTRUMENT TRANSFORMERS

- A. Inspect for physical damage.
- B. Inspect nameplate information for compatibility with one-line drawings.
- C. Verify the transformers' connections with the system requirements.
- D. Verify tightness of all bolted connections and assure adequate clearances exist from primary circuits to secondary circuit wiring and to grounds.
- E. Verify that all required grounding and shorting connections exist and that those connections have good contact; i.e. sufficient surface area, good cleanliness, and proper pressure.
- F. Test the proper operation of transformer withdrawal mechanism and the grounding operation when applicable.
- G. Verify proper primary and secondary fuses and required sizes.

3.4 PROTECTIVE RELAYS

- A. All relays shall be inspected for physical damage.
- B. Inspect cover gaskets and cover glass for presence of foreign material and moisture and then clean.

3.5 METERING AND INSTRUMENTATION

- A. Examine all devices for broken parts, damage and wire connection tightness.
- B. Meter selector switches and/or buttons shall be inspected for proper application and operation.

3.6 BATTERY SYSTEMS

- A. Inspect for physical damage and evidence of corrosion. Clean units.
- B. Measure system charging voltage and each individual cell voltage.
- C. Measure the electrolyte specific gravity and level.

- D. Verify and compare measured values with manufacturer's specifications.

3.7 MECHANICAL AND ELECTRICAL INTERLOCK SYSTEM

- A. Physically test each system to insure proper function, operation and sequencing.
- B. Closure attempt shall be made on locked open devices.
- C. Opening attempt shall be made on locked closed devices.
- D. Key exchange shall be made with devices operated in off normal positions.

3.8 OUTDOOR BUS STRUCTURES

- A. Examine bus and supports for defects, such as cracked welds, chipped porcelains, etc.
- B. Check tightness of accessible bolted bus joints by calibrated torque wrench method. Refer to manufacturer's instruction for proper foot pound levels.
- C. Inspect for evidence of foreign material such as bird nests, collection of dust, missing or damaged rain guards.
- D. Inspect for cleanliness.

3.9 METAL ENCLOSED BUS DUCT

- A. Bus shall be inspected for physical damage, cleanliness and proper connection in accordance with the single line diagram.
- B. Inspect for proper bracing, suspension, alignment and enclosure ground.
- C. Check tightness of bolted joints by calibrated torque wrench method.
- D. Make close inspection for any indication of environmental influence on the bus enclosure (i.e. foreign material) which could affect insulation resistance by reducing clearance phase-to-phase or phase-to-ground.

3.10 GROUND FAULT SYSTEMS

- A. Inspect for physical damage.
- B. Inspect the neutral main bonding connection to assure:
 - 1. Zero sequence system is grounded upstream of sensor.
 - 2. Ground strap systems are grounded down stream from the sensing device.
 - 3. Ground connection is made ahead of the neutral disconnect link.
- C. Monitor panels (if present) shall be manually operated for:
 - 1. Trip tests.
 - 2. No trip tests.

3. Nonautomatic reset.
4. Ground fault device circuit nameplate identification shall be verified by device operation.
5. Insure control circuit has disconnectable fuse device with current limiting fuses.

3.11 CABLES

A. Visual and Mechanical Inspections:

1. Inspect exposed sections for physical damage.
2. Verify cable is supplied and connected in accordance with single line diagram.
3. Inspect for shield grounding, cable support and termination.
4. If cables are terminated through window type C.T.'s make an inspection to verify that neutrals and grounds are properly terminated for normal operation of protective devices.
5. Inspect for visual jacket and insulation condition.
6. Visible cable bends shall be checked against ICEA or manufacturer's minimum allowable bending radii -- 12 times the diameter for tape shielded cables.
7. Inspect for proper fireproofing in common cable areas.
8. There shall be NO tests performed on existing cable without specific direction from the Engineer.

B. Electrical Tests -- Below 600 Volts:

1. All secondary cables from the utility transformer(s) to the secondary switchboard(s) shall be subjected to insulation tests using a 500 vdc megger.
2. Visually inspect cables, lugs, connectors and all other components for physical damage and proper connections
3. Check all cable connectors for tightness (with a torque wrench) and clearances. Torque test conductor and bus terminations to manufacturer's recommendations.
4. Check for proper grounding resistance at all services and at transformers. Resistance shall be 5 ohms maximum.

3.12 PANELBOARDS

- #### **A.**
- Torque all the connections per the manufacturers spec. Verify phase wires, color coding, separate neutral and mechanical bonding. Verify circuit breaker operation. Verify the directory is typed and reflects as-built conditions.

3.13 LIGHT FIXTURES

- #### **A.**
- Check the bonding and proper lumen output and orientation where applicable. Verify that recessed fixtures are installed with hold down clips where required. Confirm operation of the fixture with the proper switch or sensor.

3.14 OCCUPANCY SENSORS

- A. Confirm operation of the sensor per the manufacturers spec.

3.15 BATTERY PACK EMERGENCY LIGHTING

- A. Verify the operation per the manufacturers spec and run all of the diagnostic steps. Confirm proper grounding and location.

END OF SECTION

SECTION 26 0519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLE

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required for furnishing and installing required wiring and cabling systems including pulling, terminating and splicing.

1.2 REFERENCES

- A. Applicable provisions of Division 1 govern work under this Section
- B. Section 260533 Raceway and Boxes
- C. Section 260553 Identification

1.3 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Conductor sizes are based on copper.
- C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet project conditions.
- D. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All wire shall be new, delivered to the site in unbroken cartons and shall be less than one year old out of manufacturer's stock.
- B. All conductors shall be copper.
- C. Insulation shall have a 600 volt rating.
- D. Stranded conductors may only be terminated with UL OR ETL Listed type terminations or methods: e.g. stranded conductors may not be wrapped around a terminal screw but must be terminated with a crimp type device or must be terminated in an approved back wired method.

2.2 BUILDING WIRE

- A. Acceptable Manufacturers: American Insulated Wire Corp., BICC General Cable Industries Inc., Cerro Wire & Cable Co. Inc., Pirelli Cable Corp., Rome Cable Corp., or Southwire Co.

B. Single Conductor Insulated Wire.

1. FEP, THHN, THW, THW-2, THWN, THWN-2, XHH, XHHW, or XHHW-2: Wiring in dry or damp locations (except where special type insulation is required).
2. THWN, THWN-2, XHHW, XHHW-2, USE, or USE-2: Wiring in wet locations (except where type USE or USE-2 insulated conductors are specifically required, or special type insulation is required).
3. THHN, THWN or THWN-2: Wiring installed in existing raceway systems (except where special type insulation is required).
4. THHN, THW-2, THWN-2, XHHW, or XHHW-2: Wiring for electric discharge lighting circuits (fluorescent, HID), except where fixture listing requires wiring rated higher than 90° C.

2.3 METAL CLAD CABLE (TYPE MC)

- A. Acceptable Manufacturers: Southwire, AFC Cable Systems Inc., Coleman Cable Co.
- B. Comply with NFPA 70, Article 330.
- C. Interlocked flexible galvanized steel armor sheath, conforming to UL requirements for type MC metal clad cable.
- D. Insulated copper conductors, suitable for 600 volts, rated 90°C, one of the types listed in NFPA 70 Table 310.104(A) or of a type identified for use in Type MC cable.
- E. Internal full size copper ground conductor with green insulation.
- F. Connectors for MC cable: Bridgeport, Arlington Industries Inc.'s Saddle grip, or Thomas & Betts Co.'s Tite-Bite with anti-short bushings.

2.4 METAL CLAD FEEDER CABLE (TYPE MC)

- A. Copper Conductors
 1. Acceptable Manufacturers: Southwire Armorlite, AFC Cable Systems, Inc.
 2. MC feeders with copper conductors are acceptable for use as services and feeders circuits #8 AWG and larger.
 3. MC feeders shall be installed and may be used for all installations "permitted" under NFPA 70, Article 330.
 4. All MC feeders must be UL Listed and passed all requirements of UL 1569.
 5. Conductors shall be suitable for 600 volts, rated 90°C dry / 75°C wet, insulated with THHN/THWN-2 or XHHW-2 insulation with color codes as identified in this section. Equipment grounding conductor may be either bare or insulated copper conductor. For parallel installation copper equipment ground must be sized per NEC Table 250.122.
 6. Interlocked flexible aluminum armor sheath, conforming to UL requirements for type MC metal clad cable.
 7. Provide black blue gray flame retardant PVC jacketing.

8. Connectors for MC feeder cable: Bridgeport, Arlington, or Service Wire Co listed for use with Metal-Clad cable, Type MC, employing interlocked aluminum tape.

2.5 NONMETALLIC SHEATHED CABLE (TYPE NM)

- A. Acceptable Manufacturers: Southwire, Encore Wire.
- B. Comply with NFPA 70, Article 334.
- C. Conductors shall be UL-listed Type NM-B, suitable for operation at 600 volts in all installations as specified in the National Electrical Code.
- D. Manufactured as 2, 3, or 4 conductor cable, with a bare ground wire. Copper conductors are annealed (soft) copper. Stranded conductors are compressed stranded. Conductor insulation is 90°C-rated polyvinyl chloride (PVC), nylon jacketed.
- E. Cable jacket is color-coded for quick size identification; White 14 AWG, Yellow 12 AWG, Orange 10 AWG, and Black 8 AWG and 6 AWG.

2.6 MINERAL INSULATED CABLE (TYPE MI)

- A. Acceptable Manufacturers: AFC Cable Systems' Type MI Cable, or BICC/Pyrotenax Mineral Insulated System 1850 Pyrotenax Cable.
- B. Copper conductors.
- C. Seamless copper sheath.
- D. Two (2) hour fire resistive rating UL system classified, listed in UL Building Materials Directory product category Electrical circuit Protective Systems (FHIT), or Fire Resistive Cables (FHJR).
- E. 600 volt rating.
- F. Fittings and accessories as required for a complete system to suit listing and installation conditions.

2.7 WIRING CONNECTORS

- A. Split Bolt Connectors: Not acceptable unless noted otherwise.
- B. Solderless Pressure Connectors: High copper alloy terminal. May be used only for cable termination to equipment pads or terminals. Not approved for splicing.
- C. Spring Wire Connectors: Solderless spring type pressure connector with insulating covers for copper wire splices and taps. Use for conductor sizes 10 AWG and smaller.
- D. All wire connectors used in underground or exterior pull boxes shall be gel filled twist connectors or a connector designed for damp and wet locations.
- E. Mechanical Connectors:
 1. Bolted type tin-plated; high conductivity copper alloy; spacer between conductors; beveled cable entrances.

F. Insulated Connector Blocks:

1. Conductor count, size, and entry configuration to match application.
2. UV rated.
3. Dual rated for use with copper or aluminum conductors.
4. 600 volt, 90° C termination rating.
5. Caps for sealing wrench access port.

G. Compression (crimp) Connectors:

1. Long barrel; seamless, tin-plated electrolytic copper tubing; internally beveled barrel ends. Connector shall be clearly marked with the wire size and type and proper number and location of crimps.

2.8 TAGS

A. Precision engrave letters and numbers with uniform margins, character size minimum 3/16 inches high.

1. Phenolic: Two (2) color laminated engraver's stock, 1/16 inch minimum thickness, machine engraved to expose inner core color (white).
2. Aluminum: Standard aluminum alloy plate stock, minimum .032 inches thick, engraved areas enamel filled or background enameled with natural aluminum engraved characters.

2.9 WIRE MANAGEMENT

A. Cable Clamps and Clips, Cable Ties, Spiral Wraps, etc: Catamount/T&B Corp., or Ideal Industries Inc.

PART 3 - EXECUTION

3.1 GENERAL WIRING METHODS

A. Install electrical cable, wire and connectors as indicated, in accordance with the manufacturer's written instructions, the applicable requirements of NEC, and as required to ensure that products serve the intended functions.

B. Cables shall be selected on the basis of their purpose and UL listing.

1. Generally, use Types THWN, XHHW and THHN in building interiors and other dry locations.
2. Outdoors and in underground raceways, use Type THWN or other conductor type rated for wet location as required by NEC 300.5(B).
3. Conductors subject to abrasion, such as in lighting poles, shall be Type THWN or THHN.

- C. All wire and cable shall be installed in conduit.
- D. MC cable may be used in the following applications:
 - 1. Branch circuit wiring in wood framed construction (wood joists and wood stud partitions):
 - a. Install conductors parallel with joists or studs and attach to the side of these timbers by galvanized straps spaced not more than 6 feet apart.
 - b. Install conductors through holes bored in the center of the timbers when running at right angles to joists or studs.
 - c. Do not attach the conductors to the edge of joists or studs.
- E. Do not use wire smaller than 12 AWG for power and lighting circuits. Minimum size for control circuits shall be 14 AWG copper stranded.
- F. All conductors shall be sized to prevent excessive voltage drop at rated circuit ampacity.
- G. As a minimum use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 100 feet, and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet.
- H. Make conductor lengths for parallel conductors equal.
- I. Splice only in junction or outlet boxes.
- J. No conductor less than 10 AWG shall be installed in exterior underground conduit.
- K. Neatly train and lace wiring inside boxes, equipment, and panelboards.

3.2 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Use Listed wire pulling lubricant for pulling 4 AWG and larger wires and for other conditions when necessary. Do NOT use pulling lubricant on isolated (ungrounded) power systems.
- B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- C. Completely and thoroughly swab raceway system before installing conductors.
- D. Place all conductors of a given circuit (this includes phase wires, neutral (if any), and ground conductor) in the same raceway. If parallel phase and/or neutral wires are used, then place an equal number of phase and neutral conductors in same raceway or cable.

3.3 WIRING CONNECTIONS AND TERMINATIONS

- A. Splice only in accessible junction boxes.
- B. Wire splices and taps shall be made firm, and adequate to carry the full current rating of the respective wire without soldering and without perceptible temperature rise.
- C. All splices shall be so made that they have an electrical resistance not in excess of two feet (600 mm) of the conductor.

- D. Use solderless spring type pressure connectors with insulating covers for wire splices and taps, 10 AWG and smaller.
- E. Use mechanical or compression connectors for wire splices and taps, 8 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of conductor.
- F. Thoroughly clean wires before installing lugs and connectors.
- G. At all splices and terminations, leave tails long enough to cut splice out and completely re-splice.
- H. Protect wiring in device and junction boxes from paint overspray. Wiring covered with paint shall be removed and replaced where needed by the Contractor.

3.4 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 260504 Cleaning and Testing.

3.5 WIRE COLOR

- A. For wire sizes 10 AWG and smaller - Wire shall be colored as indicated below.
- B. For wire sizes 8 AWG and larger – Use colored wire, or identify wire with colored $\frac{1}{2}$ " or $\frac{3}{4}$ " tape bands at all terminals, splices and boxes. Tape bands shall be installed at every 12" for the entire visible length. Colors to be as indicated below.
- C. In new facilities, use the following color scheme:
 - 1. Black and red for single phase circuits at 120/240 volts
 - 2. Phase A black, Phase B red and Phase C blue for circuits at 120/208 volts single or three phase.
 - 3. Phase A brown, Phase B orange and Phase C yellow for circuits at 277/480 volts single or three phase.
 - 4. Conductor 1 orange with at least one distinctive colored stripe other than white, green, or gray, Conductor 2 brown with at least one distinctive colored stripe other than white, green, or gray, Conductor 3 yellow with at least one distinctive colored stripe other than white, green, or gray for isolated (ungrounded) circuits at 120/208 volts three phase.
 - 5. Neutral Conductors: White for 120/208V and 120/240V systems, Gray for 277/480V systems. Where there are two or more neutrals in one conduit, each shall be individually identified with a different stripe.
 - 6. Note: This includes fixture whips except for Listed whips mounted by the fixture manufacturer on the fixture and Listed as a System.
- D. All switch legs shall be the same color as their associated circuit. Traveler conductors run between 3 and 4 way switches shall be colored pink or purple.

- E. Ground Conductors: Green for 2 AWG and smaller. For 1 AWG and larger, identify with green colored wire, or with green tape at both ends and at all access points, such as panelboards, motor starters, disconnects and junction boxes.
- F. More Than One Nominal Voltage System Within A Building: Permanently post the color coding scheme at each branch-circuit panelboard.

3.6 IDENTIFICATION

- A. Identification Tags: Use tags to identify feeders and designated circuits. Install tags so that they are easily read without moving adjacent feeders or requiring removal of arc proofing tapes. Attach tags with non-ferrous wire or brass chain.
 - 1. Interior Feeders: Identify each feeder in pullboxes and gutters. Identify by feeder number and size.
 - 2. Exterior Feeders: Identify each feeder in manholes and in interior pullboxes and gutters. Identify by feeder number and size, and also indicate building number and panel designation from which feeder originates.
 - 3. Street and Grounds Lighting Circuits: Identify each circuit in manholes and lighting standard bases. Identify by circuit number and size, and also indicate building number and panel designation from which circuit originates.
- B. Identification Plaque: Where a building or structure is supplied by more than one service, or has any combination of feeders, branch circuits, or services passing through it, install a permanent plaque or directory at each service, feeder and branch circuit disconnect location denoting all other services, feeders, or branch circuits supplying that building or structure or passing through that building or structure and the area served by each. Minimum engraved plaque size of 8"x6".

3.7 WIRE MANAGEMENT

- A. Use wire management products to bundle, route, and support wiring in junction boxes, pullboxes, wireways, gutters, channels, and other locations where wiring is accessible.

3.8 BRANCH CIRCUITS

- A. The use of single-phase, multi-wire branch circuits with a common neutral is not permitted. All branch circuits shall be furnished and installed with an individual accompanying neutral, sized the same as the phase conductors.
- B. The use of a common neutral for modular furniture will be allowed with the following conditions:
 - 1. (Three) 3-phase circuit breaker is used.
 - 2. Neutral is sized 200% larger than phase conductor.

3.9 EMERGENCY CIRCUITS

- A. All emergency system wiring (Level 1 and Level 2) shall be installed in separate raceways after their associated transfer switches. The wiring shall be separate from each other and from all normal system wiring.

END OF SECTION

SECTION 26 0523 - CONTROL CABLES

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the required remote control and signal cabling indicated by the Contract Documents with supplementary items necessary for proper installation.

1.2 REFERENCES

- A. Applicable provisions of Division 1 govern work under this Section.
- B. Section 260533 Raceway and Boxes.
- C. Section 260553 Identification.
- D. NFPA 70 National Electrical Code.

1.3 PROJECT CONDITIONS

- A. Verify that field measurements are as shown on Drawings.
- B. Conductor sizes are based on copper.
- C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.
- D. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All wire shall be new, delivered to the site in unbroken cartons and shall be less than one year old out of manufacturer's stock.
- B. All conductors shall be copper.
- C. Insulation shall have a 600 volt rating.
- D. All conductors must be suitable for the application intended. Conductors #12 and smaller may be solid or stranded with the following requirements or exceptions:
 - 1. All conductors terminated with crimp type devices must be stranded.
 - 2. Stranded conductors may only be terminated with UL OR ETL Listed type terminations or methods: e.g. stranded conductors may not be wrapped around a terminal screw but

must be terminated with a crimp type device or must be terminated in an approved back wired method.

2.2 REMOTE CONTROL AND SIGNAL CABLE

- A. Refer to Division 28 for requirements for cable to be used on safety and security systems.
- B. Refer to Division 27 for requirements for cable to be used on communication systems.
- C. All other systems cabling shall meet the requirements of NEC Article 725 and the following:
 - 1. Control Cable for Class 1 Remote Control and Signal Circuits: 600 volt insulation, individual conductors twisted together, shielded (where required), and covered with an overall PVC jacket.
 - a. Cable shall be Listed, temperature rated, and plenum or non-plenum rated for the application as required in the National Electrical Code.
 - 2. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits shall be constructed, Listed, temperature rated, and plenum or non-plenum rated for the application as required in the NEC Article 725.

2.3 WIRING CONNECTORS

- A. Split Bolt Connectors: Not acceptable.
- B. Spring Wire Connectors: Solderless spring type pressure connector with insulating covers for copper wire splices and taps. Use for conductor sizes 10 AWG and smaller.
- C. All wire connectors used in underground or exterior pull boxes shall be gel filled twist connectors or a connector designed for damp and wet locations.

PART 3 - EXECUTION

3.1 GENERAL WIRING METHODS

- A. Low voltage control and signal cables shall be installed in conduit. However, they may be installed without conduit above accessible ceilings if the cable meets NEC requirements for the application, unless specified to be in conduit in other sections of the specifications. See requirements for free-air cabling installation below.
- B. Do not use wire smaller than 14 AWG for control wiring greater than 60 volts, or 18 AWG for voltages less than 60 volts, all sizes subject to NEC 725 requirements.
- C. Splice only in junction boxes.
- D. Identify wire per section 260553.
- E. Neatly train and lace wiring inside boxes, and equipment.

3.2 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time.
- B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- C. Completely and thoroughly swab raceway system before installing conductors.
- D. Place all conductors of a given circuit (this includes phase wires, neutral (if any), and ground conductor in the same raceway.

3.3 FREE-AIR CABLE INSTALLATION

- A. Free-air installation is allowed for low voltage cabling associated with the following systems:
 - 1. Fire alarm
 - 2. Technology cabling (where cable tray is not available)
 - 3. Control cables (DDC, digital lighting control system, etc.)
- B. 'Free-Air' wiring runs shall avoid areas of high traffic (i.e. aisle way), open structure when possible, be run as close as possible to outlining walls and above accessible ceilings when possible.
- C. Cabling shall be neatly run at right angles and be kept clear of other trades work.
- D. Cabling shall be supported at a maximum of 4-foot intervals utilizing mounting bridal rings or J-hooks anchored to the wall, overhead structure, piping supports or structural steel beams. If cable sag at mid-span exceeds 12-inches, another support shall be provided. **Fire alarm cabling shall be installed in a dedicated support system of J-hooks and/or bridal rings separate from all other low voltage cabling.**
- E. Mounting rings/hooks shall be designed to maintain cables bend to larger than the minimum bed radius (typically 4 x cable diameter).
- F. Bundle cabling together, where possible, using Velcro straps. **The use of zip ties for cable bundling is NOT allowed.**
- G. Cabling being routed above an inaccessible ceiling exceeding 6' in length shall be sleeved using raceway for ease of cable installation and replacement.
- H. Cabling shall not be attached to or supported by other systems, including but not limited to: cabling, plumbing or piping, ductwork, suspended ceiling supports or electrical conduit. Additionally, cabling shall not be laid directly on the ceiling grid.
- I. To reduce or eliminate Electro-Magnetic Interference (EMI), the following minimum separation distances for 'Free-Air' cabling installations shall be adhered to:
 - 1. Twelve (12) inches from power lines of less than 5kV.
 - 2. Thirty-nine (39) inches from power lines of 5kV or greater.

3. Eighteen (18) inches from lighting fixtures.
 4. Thirty-nine (39) inches from transformers and motors.
- J. A coil of six (6) feet in each cable shall be placed in the ceiling at each 'free-air' wire device. These coils shall be secured (wire tied) at the last cable support before the cable reaches the device and shall be coiled from 100% to 200% of the cable recommended minimum bend radius.
 - K. All cable shall be free of tension at both ends. Nylon strain relief connectors shall be provided at each device and junction box where cables enter. In cases where the cable must bear some stress, Kellum type grips may be used to spread the strain over a longer length of cable.
 - L. Cable manufacturers minimum bend radius shall be observed in all instances. Care should be taken in the use of cable ties to secure and anchor the station cabling. Ties should not be over tightened as to compress the cable jacket. No sharp burrs should remain where excess length of the cable tie has been cut.
 - M. All exposed vertical cable extensions to devices located below the finished ceiling shall be in conduit.
 - N. Provide protection for exposed cables where subject to damage.
 - O. Use suitable cable fittings and connectors.

3.4 WIRING CONNECTIONS AND TERMINATIONS

- A. Splice only in accessible junction boxes.
- B. All splices shall be so made that they have an electrical resistance not in excess of two (2) feet (600 mm) of the conductor.
- C. Use solderless spring type pressure connectors with insulating covers for wire splices and taps, 10 AWG and smaller.
- D. Thoroughly clean wires before installing lugs and connectors.
- E. At all splices and terminations, leave tails long enough to cut splice out and completely re-splice.
- F. Protect wiring in device and junction boxes from paint overspray. Wiring covered with paint shall be removed and replaced where needed by the Contractor.

3.5 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 260504.

END OF SECTION

SECTION 26 0526 - GROUNDING

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the following grounding indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Equipment included in this Section
 - 1. Grounding electrodes and conductors
 - 2. Equipment grounding conductors
 - 3. Bonding.

1.2 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All design, materials, installation and testing pertaining to grounding and bonding system shall comply with the latest edition of applicable requirements and standards addressed within the following references:
 - 1. Applicable provisions of Division 1 govern work under this Section
 - 2. Section 260519 – Low Voltage Electrical Power Conductors and Cable
 - 3. NFPA 70 - National Electrical Code.
 - 4. ANSI/IEEE 142 (Latest edition) - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - 5. IEEE 81 - Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Ground System.
 - 6. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment (IEEE Emerald Book).
 - 7. IEEE C2 - National Electrical Safety Code (NESC).
 - 8. UL 467 – Grounding and Bonding Equipment.
 - 9. UL 497 - Protectors for Paired-Conductor Communications Circuits.
 - 10. UL 497A - Secondary Protectors for Communications Circuits.
 - 11. UL 497B - Protectors for Data Communications and Fire-Alarm Circuits

12. UL 1449 - Standard for Safety Surge Protective Devices
13. BICSI Telecommunications Distribution Methods Manual (TDMM), Latest Edition.
14. ANSI J-STD-607-A – Commercial Building Grounding and Bonding Requirements for Telecommunications.

1.3 QUALITY ASSURANCE

- A. See Part 3 of this Specification for system requirements and performance requirements.

1.4 SUMMARY

- A. Ground the electrical service system neutral at service entrance equipment to grounding counterpoise loop. Electrical systems that are grounded shall be connected to earth in a manner that will limit the voltage imposed by lightning, line surges, or unintentional contact with higher-voltage lines and that will stabilize the voltage to earth during normal operations. Provide a completely grounded system in accordance with Article 250 of the NEC
- B. Metal water piping system(s) installed in or attached to a building or structure shall be bonded to the service equipment enclosure, the grounded conductor at the service. Where installed in or attached to a building or structure, a metal piping system(s), including gas piping, that is likely to become energized shall be bonded to the service equipment enclosure, the grounded conductor at the service. The bonding jumper(s) shall be sized in accordance with Article 250 of the NEC.
- C. Ground each separately-derived system neutral to separate ground buses that are installed in nearest electrical rooms. Transformers, UPS systems, power conditioners, inverters, or other power supplies are separately derived systems. Standby or emergency generators are separately derived systems if the neutral is bonded to the generator frame and if there is no direct connection of the generator neutral conductor to the service neutral conductor.
- D. Concrete reinforcing bars shall be permitted for grounding. Connect the structural metal frame to the reinforcing bars of concrete-encased electrode. Concrete-encased electrodes of existing buildings or structures shall not be required to be part of the grounding electrode system where the steel reinforcing bars or rods are not accessible for use without disturbing the concrete.
- E. Provide communications system-grounding conductor at point of service entrance and connect to telecommunications grounding busbars. Bond together the communications system grounding.
- F. Bond together system service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, metal cable trays, auxiliary gutters, meter fittings, boxes, cable armor, cable sheath, ground bus in electrical rooms, metal frame of the building or structure, ground ring, lightning down lead conductor, grounding conductor in raceways and cables, receptacle ground connectors, and metallic plumbing systems.

1.5 CERTIFICATIONS

- A. Two (2) weeks prior to final inspection, submit four (4) copies of the following to the Engineer and General Contractor/Construction Manager:
 1. Certification that the materials and installation is in accordance with the drawings and specifications.

2. Certification, by the Contractor, that the complete installation has been properly installed and tested.

1.6 CLOSEOUT SUBMITTAL AND PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of grounding electrodes. Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.
- B. Test Reports: Indicate overall resistance to ground and resistance of each electrode

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. Grounding system components shall be as required to comply with the design and construction of the system indicated. Components shall be as indicated in manufacturer's submittal data.

2.2 ROD ELECTRODE

- A. Material: Copper-clad steel.
- B. Diameter: 3/4 inch minimum.
- C. Length: Ten (10) feet minimum.

2.3 PLATE ELECTRODE

- A. Copper plates minimum 0.06 inches thick by 2'-0" square feet of surface area.

2.4 MECHANICAL CONNECTORS

- A. Products:
 1. Ground Clamps (Cable to Pipe):
 - a. Blackburn/T&B Corp.'s GUV
 - b. Framatome Connectors/Burndy Corp.'s GAR, GD, GP, GK
 - c. OZ/Gedney Co.'s ABG, CG
 2. Ground Clamps (Cable to Rod):
 - a. Blackburn/T&B Corp.'s GG, GGH, JAB, JABH, GUV
 - b. Dossert Corp.'s GN, GPC
 - c. Framatome Connectors/Burndy Corp.'s GP, GX, GRC
 - d. OZ/Gedney Co.'s ABG
 3. Ground Lugs - Copper, one (1) or two (2) hole style (to suit conditions), long barrel:
 - a. Anderson/Hubbell's VERSAtile VHCL
 - b. Blackburn/T&B Corp.'s Color-Coded CTL, LCN

- c. Framatome Connectors/Burndy's Hylug YA
 - d. Electrical Products Div./3M Scotchlok 31036 or 31145 Series
 - e. Ideal Industries Inc.'s CCB or CCBL
 - f. Thomas & Betts Corp.'s 54930BE or 54850BE Series
- B. The mechanical connector bodies shall be manufactured from high strength, high conductivity cast copper alloy material. Bolts, nuts, washers and lockwashers shall be made of Silicon Bronze and supplied as a part of the connector body and shall be of the two bolt type.
 - C. Split bolt connector types are NOT allowed. Exception: the use of split bolts is acceptable for grounding of wire-basket type cable tray, and for cable shields/straps of medium voltage cable.
 - D. The connectors shall meet or exceed UL 467 and be clearly marked with the catalog number, conductor size and manufacturer.

2.5 COMPRESSION CONNECTORS

- A. The compression connectors shall be manufactured from pure wrought copper.
- B. The conductivity of this material shall be no less than 99% by IACS standards.
- C. The connectors shall meet or exceed the performance requirements of IEEE 837, latest revision.
- D. The installation of the connectors shall be made with a compression, tool and die system, as recommended by the manufacturer of the connectors.
- E. The connectors shall be clearly marked with the manufacturer, catalog number, conductor size and the required compression tool settings.
- F. Each connector shall be factory filled with an oxide-inhibiting compound.

2.6 EXOTHERMIC CONNECTIONS

- A. As manufactured by Erico (Cadweld), T&B (Furseweld) or similar.

2.7 GROUND CONDUCTORS

- A. Material:
 - 1. Provide 600-volt insulated copper (aluminum not permitted) conductors having a green-colored insulation for grounding electrode and equipment grounding conductors. Use stranded conductors.
 - 2. Conduit grounding conductors shall be insulated copper conductor, green in color to size 2 AWG. Insulated conductors larger than 2 AWG shall be same as phase conductors but identified with green or green/yellow tape at each accessible opening or location in raceway.
 - 3. Provide bare conductors for bonding jumpers.
 - 4. Provide tinned copper conductors for exterior installations.

5. Communications cable tray grounding conductors shall be a minimum of 6 AWG bare copper conductor.
- B. Grounding Electrode Conductor: Size as shown on drawings, specifications or as required by NFPA 70, whichever is larger.
- C. Foundation Electrodes: As shown on drawings or details.
- D. Feeder and Branch Circuit Equipment Ground: Size as shown on drawings, specifications or as required by NFPA 70, whichever is larger. Differentiate between the normal ground and the isolated ground when both are used on the same facility.

2.8 GROUNDING BUSBAR

- A. Where a field-provided ground bus or ground bar is required, use round-edge copper bar with 98 percent International Annealed Copper Standard (IACS) conductivity
- B. Size the bus for not less than 25 percent of the cross-sectional areas of the related feeder. A minimum size of ¼-inch thick by 2-inch depth by 6-inch length (minimum) is required.
 1. The ground bar shall be a predrilled copper busbar provided with standard NEMA bolt hole sizing and spacing for the type of connectors to be used.
 2. The ground bar shall be tin-plated for reduced contact resistance.
 3. The ground bar shall be insulated from its support. A minimum of 2 inches separation is required. Mount the grounding busbars on insulated standoffs to ensure isolation from ground potential or stray potentials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 GENERAL

- A. Install Products in accordance with manufacturer's instructions.
- B. Install grounding conductors continuous, without splice or connection, between equipment and grounding electrodes.
- C. Size: When grounding and bonding conductors are not sized on Drawings, size the grounding conductors in accordance with NEC. Size bonding jumper so that minimum cross-sectional area is greater than or equal to that of the equivalent grounding conductor as determined from NEC.
- D. Mechanical connections shall be accessible for inspection and checking. No insulation shall be installed over mechanical ground connections.
- E. Ground connection surfaces shall be cleaned and all buried or inaccessible connections shall be made so that it is impossible to move them.

- F. Attach grounds permanently before permanent building service is energized.
- G. All grounding electrode conductors shall be installed in PVC conduit, in exposed locations.

3.3 LESS THAN 600 VOLT SYSTEM GROUNDING

- A. System Grounding:
 - 1. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.
 - 2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
- B. Metallic Piping, Building Steel, and Supplemental Electrode(s)
 - 1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water and gas pipe systems, building steel, and supplemental or made electrodes. Jumper insulating joints in the metallic piping. All connections to electrodes shall be made with fittings that conform to UL 467.
- C. Provide a supplemental ground electrode and bond to the grounding electrode system. Use driven ground rod(s) on exterior of building.
- D. Service Disconnect (Separate Individual Enclosure): Provide a ground bar bolted to the enclosure with lugs for connecting the various grounding conductors
- E. Switchgear, Switchboards, Unit Substations, and Motor Control Centers:
 - 1. Connect the various feeder equipment grounding conductors to the ground bus in the enclosure with suitable pressure connectors.
 - 2. For service entrance equipment, connect the grounding electrode conductor to the ground bus.
 - 3. Connect metallic conduits, which terminate without mechanical connection to the housing, by grounding bushings and grounding conductor to the equipment ground bus.
- F. Transformers:
 - 1. Exterior: Exterior transformers supplying interior service equipment shall have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.
 - 2. Separately derived systems (transformers downstream from service equipment): Ground the secondary neutral at the transformer. Provide a grounding electrode conductor from the transformer to the nearest component of the grounding electrode system.
- G. Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.
- H. Conduit System:
 - 1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.

2. Non-metallic conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.
 3. Install an insulated grounding conductor internally to all flexible metal conduits. All flexible metal conduit containing power circuits shall utilize grounding bushings. The grounding bushing shall contain a bonding jumper and shall be terminated at the equipment ground bus. The grounding conductor shall terminate at the equipment ground bus. Install external ground wire on liquid tight flexible metal conduit. Provide suitable grounding bushing at each end of liquid tight flexible metal conduit at transformers. External ground wire shall be in addition to grounding conductors installed internal to raceway system.
 4. Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.
- I. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.
- J. Boxes, Cabinets, Enclosures, and Panelboards:
1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
 2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
 3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.
- K. Motors and Starters: Provide lugs in motor terminal box and starter housing or motor control center compartment to terminate equipment grounding conductors.
- L. Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.
- M. Ground lighting fixtures to the equipment grounding conductor of the wiring system when the green ground is provided; otherwise, ground the fixtures through the conduit systems. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.
- N. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.

3.4 CONDUCTIVE PIPING

- A. Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.
- B. In operating rooms and at intensive care and coronary care type beds, bond the gases and suction piping, at the outlets, directly to the room or patient ground bus.

3.5 COMMUNICATIONS SYSTEM GROUNDING

A. General:

1. Route ground conductors to provide the shortest, most direct path from point to point. Telecommunications ground must be bonded to the lightning protection system grounding and may need additional bonding depending on: spacing, building dimensions, and construction.
2. Bonding conductors should not be placed in ferrous metallic conduit. If it is necessary to place bonding conductors in ferrous metallic conduit that exceeds 3 feet in length, the conductors shall be bonded to each end of the conduit with a conductor sized as a No. 6 AWG, minimum (this makes the conduit a parallel path with the cable). The connections of the bonding conductors for telecommunications shall utilize listed two-hole compression lugs.
3. A continuous ground path shall be provided in all telecommunications raceways. Grounded cable trays shall be considered continuous ground path.
4. Any grounding or bonding conductor that is run through a metallic conduit shall be bonded to the conduit.
5. Telecommunications primary protector grounding conductor shall be bonded to the ground bus in the room. A minimum of 1 foot separation shall be maintained between this insulated conductor and any DC power cables, switchboard cables, or high frequency cables, even when placed in metal raceway.
6. In buildings where the backbone telecommunications cabling incorporates a shield or metallic member, this shield or metallic member shall be bonded to the ground bus in the room where the cables are terminated or where pairs are broken out.

3.6 CORROSION INHIBITORS

- #### **A.**
- When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.7 GROUND ROD INSTALLATION

- #### **A.**
- Drive each rod vertically in the earth, not less than 10 feet in depth.
- #### **B.**
- Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.
- #### **C.**
- Where rock prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified resistance.

3.8 GROUND RESISTANCE

- #### **A.**
- Grounding system resistance to ground shall not exceed 5 ohms. Make necessary modifications or additions to the grounding electrode system for compliance without additional cost to the Owner. Final tests shall assure that this requirement is met.

- B. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.
- C. Services at power company interface points shall comply with the power company ground resistance requirements.
- D. Engineer has the option to observe below-grade connections prior to backfilling. The Contractor shall notify the Engineer 24 hours before the connections are ready for observation.

3.9 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

END SECTION

SECTION 26 0529 – HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the following hangers and supports indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Equipment included in this Section
 - 1. Conduit and equipment supports
 - 2. Straps
 - 3. Clamps
 - 4. Steel channel, etc.
 - 5. Fastening hardware for supporting electrical work.

1.2 REFERENCES

- A. Applicable provisions of Division 1 govern work under this Section.

1.3 QUALITY ASSURANCE

- A. Support systems shall be adequate for the weight of equipment and conduit, including wiring, which they carry.

PART 2 - PRODUCTS

2.1 ANCHORING DEVICES

- A. Sleeve Anchors
 - 1. Molly/Emhart's Parasleeve Series
 - 2. Phillips' Red Head Dynabolt Series
 - 3. Ramset's Dynabolt Series
- B. Wedge Anchors
 - 1. Hilti's Kwik Bolt Series
 - 2. Molly/Emhart's Parabolt Series
 - 3. Phillips' Red Head Trubolt
 - 4. Ramset's Trubolt Series

- C. Concrete Screw Anchors
 - 1. Phillips' Red Head Tapcon
- D. Non-Drilling Anchors
 - 1. Hilti's Drop-In Anchor Series
 - 2. Phillips' Red Head Multi-Set II Series
 - 3. Ramset's Dynaset Series
- E. Stud Anchors
 - 1. Phillips' Red Head JS Series

2.2 CAST-IN-PLACE CONCRETE INSERTS

- A. Continuous Slotted Type Concrete Insert, Galvanized:
 - 1. Load Rating 1300 lbs./ft.: Kindorf's D-986
 - 2. Load Rating 2400 lbs./ft.: Kindorf's D-980
 - 3. Load Rating 3000 lbs./ft.: Hohmann & Barnard Inc.'s Type CS-H
 - 4. Load Rating 4500 lbs./ft.: Hohmann & Barnard Inc.'s Type CS-HD
- B. Threaded Type Concrete Insert: Galvanized ferrous castings, internally threaded.
- C. Wedge Type Concrete Insert: Galvanized box-type ferrous castings, designed to accept bolts having special wedge shaped heads.

2.3 HAMMER SET ANCHOR

- A. Zinc plated steel drive pin with expanding alloy body:
 - 1. Phillips' Red Head HS Series
 - 2. Hilti HIT Series
 - 3. Ramset Shuredrive Series

2.4 MISCELLANEOUS FASTENERS

- A. Except where shown otherwise on the Drawings, furnish fastener type, size, and grade required for proper installation of the Work. Select from the following:
 - 1. Cadmium or Zinc Coated Fasteners: Dry locations.
 - 2. Galvanized Fasteners: For exterior use, or for items anchored to exterior walls, except where stainless steel is indicated.

3. Stainless Steel Fasteners: Type 302 for interior Work; Type 316 for exterior Work; Phillips head screws and bolts for exposed Work unless otherwise specified.

2.5 HANGER RODS

- A. Mild low carbon steel, unless otherwise specified; fully threaded or threaded each end, with nuts as required to position and lock rod in place. Unless galvanized or cadmium plated, provide a shop coat of red lead or zinc chromate primer paint.
- B. Minimum sized threaded rod for supports shall be 3/8" for trapezes and single conduits 1-1/4" and larger, and 1/4" for single conduits 1" and smaller.

2.6 "C" BEAM CLAMPS

- A. With Conduit Hangers
 1. For 1 Inch Conduit Maximum:
 - a. B-Line Systems Inc.'s BG-8, BP-8 Series
 - b. Caddy/Erco Products Inc.'s BC-8P and BC-8PSM Series
 - c. GB Electrical Inc.'s HIT 110-412 Series
 2. For 3 Inch Conduit Maximum:
 - a. Appleton Electric Co.'s BH-500 Series beam clamp with H50W/B Series hangers
 - b. Kindorf's 500 Series beam clamp with 6HO-B Series hanger
 - c. OZ/Gedney Co.'s IS-500 Series beam clamp with H-OWB Series hanger
 3. For 4 Inch Conduit Maximum:
 - a. Kindorf's E-231 beam clamp and E-234 anchor clip and C-149 series lay-in hanger
 - b. Unistrut Corp.'s P2676 beam clamp and P-1659A Series anchor clip with J1205 Series lay in hanger
- B. For Hanger Rods
 1. For 1/4 Inch Hanger Rods:
 - a. B-Line Systems Inc.'s BC
 - b. Caddy/Erco Products Inc.'s BC
 - c. GB Electrical Inc.'s HIT 110
 - d. Kindorf's 500, 510
 - e. Unistrut Corp.'s P1648S, P2398S, P2675, P2676
 2. For 3/8 Inch Hanger Rods:
 - a. Caddy/Erco Products Inc.'s BC
 - b. Kindorf's 231-3/8, 502
 - c. Unistrut Corp.'s P1649AS, P2401S, P2675, P2676
 3. For 1/2 Inch Rods:
 - a. Appleton Electric Co. BH-500 Series
 - b. Kindorf's 500 Series, 231-1/2
 - c. OZ/Gedney Co.'s IS-500 Series
 - d. Unistrut Corp.'s P1650AS, P2403S, P2676

4. For 5/8 Inch Rods: Unistrut Corp.'s P1651AS beam clamp and P1656A Series anchor clip.
5. For 3/4 Inch Rods: Unistrut Corp.'s P1653S beam clamp and P1656A Series anchor clip.

2.7 CHANNEL SUPPORT SYSTEM

- A. Channel Material: 12 gauge steel.
- B. Finishes
 1. Phosphate and baked green enamel/epoxy.
 2. Pre-galvanized.
 3. Electro-galvanized.
 4. Hot dipped galvanized.
 5. Polyvinyl chloride (PVC), minimum 15 mils thick.
- C. Fittings: Same material and finish as channel.
- D. UL Listed Systems
 1. B-Line Systems Inc.'s B-22 (1-5/8 x 1-5/8 inches), B-12 (1-5/8 x 2-7/16 inches), B-11 (1-5/8 x 3-1/4 inches).
 2. Grinnell Corp.'s Allied Power-Strut PS 200 (1-5/8 x 1-5/8 inches), PS 150 (1-5/8 x 2-7/16 inches), PS 100 (1-5/8 x 3-1/4 inches).
 3. Kindorf's B-900 (1-1/2 x 1-1/2 inches), B-901 (1-1/2 x 1-7/8 inches), B-902 (1-1/2 x 3 inches).
 4. Unistrut Corp.'s P-3000 (1-3/8 x 1-5/8 inches), P-5500 (1-5/8 x 2-7/16 inches), P-5000 (1-5/8 x 3-1/4 inches).
 5. Versabar Corp.'s VA-1 (1-5/8 x 1-5/8 inches), VA-3 (1-5/8 x 2-1/2 inches).

2.8 MISCELLANEOUS FITTINGS

- A. Side Beam Brackets
 1. B-Line Systems Inc.'s B102, B103, B371-2
 2. Kindorf's B-915
 3. Versabar Corp.'s VF-2305, VF-2507
- B. Pipe Straps (Heavy Duty Type):
 1. Two (2) Hole Steel Conduit Straps:
 - a. B-Line Systems Inc.'s B-2100 Series

- b. Kindorf's C-144 Series
 - c. Unistrut Corp.'s P-2558 Series
- 2. One (1) Hole Malleable Iron Clamps:
 - a. Kindorf's HS-400 Series
 - b. OZ/ Gedney Co.'s 14-G Series, 15-G Series (EMT)
- C. Deck Clamps: Caddy/Erico Products Inc.
- D. Supporting Fasteners (Metal Stud Construction): Metal stud supports, clips and accessories as produced by Caddy/Erico Products Inc.

2.9 ROOFTOP SUPPORT SYSTEMS

- A. Rooftop supports for conduit, cable tray or equipment shall be provided for installation without requiring roof penetrations, flashing or damage to the roofing material. Height-adjustable supports may be used where necessary. Support conduit a minimum of 4' above the roof surface.
- B. Materials:
 - 1. Support bases shall be made of an engineered material with appropriate additives for UV protection. All structural steel components shall be hot-dipped galvanized.
 - 2. The support shall have a continuous bottom surface to provide even load distribution and minimize point loading of the roof membrane. The support base will have a radiused edge to enhance compatibility with roof membranes.
 - 3. Coordinate static load rating of the support(s) with the specific application being served.
 - 4. Accessories: Clamps, bolts, nuts, washers, and other devices as required for a complete system.
- C. Applications:
 - 1. Fixed Strut Supports: Size and load ratings for the application
 - 2. Adjustable Strut Supports: Height adjustable, size and load ratings for the application
 - 3. Adjustable Single Conduit Supports: Height adjustable, size and load ratings for the application
 - 4. Bridge Assemblies:
 - a. Suitable for multiple conduit runs, cable tray or equipment
 - b. Size and load ratings for the application
 - 5. Post Base Assemblies:
 - a. For use with vertical sections of channel support systems
 - b. Size, channel support configuration, and load ratings for the application
 - 6. Manufacturers:
 - a. Caddy/Pentair, Cooper B-Line, Mifab, Arlington, Rooftop Blox, Haydon, MAPA Products

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Where specific fasteners are not specified or indicated for securing items to in-place construction, provide appropriate type, size, and number of fasteners for a secure, rigid installation.
- B. Install anchoring devices and other fasteners in accordance with manufacturer's printed instructions.
- C. Make attachments to structural steel wherever possible.

3.2 FASTENER SCHEDULE

- A. Material
 - 1. Use cadmium or zinc coated anchors and fasteners in dry locations.
 - 2. Use hot dipped galvanized or stainless steel anchors and fasteners in damp and wet locations.
 - 3. For corrosive atmospheres or other extreme environmental conditions, use fasteners made of materials suitable for the conditions.
- B. Types and Use: Unless otherwise specified or indicated use:
 - 1. Cast-in-place concrete inserts in fresh concrete construction for direct pull-out loads such as shelf angles or fabricated metal items and supports attached to concrete slab ceilings.
 - 2. Anchoring devices to fasten items to solid masonry and concrete when the anchor is not subjected to pull out loads, or vibration in shear loads.
 - 3. Toggle bolts to fasten items to hollow masonry and stud partitions.
 - 4. Metallic fasteners installed with electrically operated or powder driven tools for approved applications, except:
 - a. Do not use powder driven drive pins or expansion nails.
 - b. Do not attach powder driven or welded studs to structural steel less than 3/16 inch thick.
 - c. Do not support a load, in excess of 250 lbs from any single welded or powder driven stud.
 - d. Do not use powder driven fasteners in precast concrete
 - 5. Metallic hammer set anchors may be used in wall and ceiling applications. Maximum conduit size supported with hammer set anchors is 1 Inch.

3.3 ATTACHMENT SCHEDULE

- A. General: Make attachments to structural steel or steel bar joists wherever possible. Provide intermediate structural steel members where required by support spacing. Select steel members for use as intermediate supports based on a minimum safety factor of 5.

1. Make attachments to steel bar joists at panel points of joists.
 2. Do not drill holes in main structural steel members.
 3. Use "C" beam clamps for attachment to steel beams.
- B. Where it is not possible to make attachments to structural steel or steel bar joists, use the following methods of attachment to suit type of construction unless otherwise specified or indicated on the drawings.
1. Attachment to Steel Roof Decking (No Concrete Fill):
 - a. Decking With Hanger Tabs: Use deck clamps.
 - b. Decking Without Hanger Tabs:
 - 1) Before Roofing Has Been Applied: Use 3/8 inch threaded steel rod welded to a 4 x 4 x 1/4 inch steel plate and installed through 1/2 inch hole in roof deck.
 - 2) After Roofing Has Been Applied: Use welding studs, or self-drilling/tapping fasteners. Exercise extreme care when installing fasteners to avoid damage to roofing.
 2. Attachment to Concrete Filled Steel Decks (Total thickness, 2-1/2 inches or more):
 - a. Before Fill Has Been Placed:
 - 1) Use thru-bolts and fish plates.
 - 2) Use welded studs. Do not support a load in excess of 250 pounds from a single welded stud.
 - b. After Fill Has Been Placed: Use welded studs. Do not support a load in excess of 250 lbs from a single welded stud.
 3. Attachment to Cast-In-Place Concrete:
 - a. Fresh Concrete: Use cast-in-place concrete inserts.
 - b. Existing Concrete: Use anchoring devices.
 4. Attachment to Cored Precast Concrete Decks:
 - a. New Construction: Use thru-bolts and fish plates before Construction Work Contractor has placed concrete fill over decks.
 - b. Existing Construction: Toggle bolts may be installed in cells for a maximum load of _____.
 5. Attachment to Hollow Block or Tile Filled Concrete Deck:
 - a. New Construction: Use cast-in-place concrete inserts by having Construction Work Contractor omitting blocks and pouring solid blocks with insert where required.
 6. Attachment to Waffle Type Concrete Decks:
 - a. New Construction:
 - 1) Use cast-in-place concrete inserts in fresh concrete.
 - 2) If concrete fill has been applied over deck, thru-bolts and fish plates may be used where additional concrete or roofing is to be placed over the deck.
 - b. Existing Construction: Use anchoring devices.
 7. Attachment to Precast Concrete Planks: Use anchoring devices, except do not make attachments to precast concrete planks less than 2-3/4 inches thick.

8. Attachment to Precast Concrete Tee Construction:
 - a. New Construction:
 - 1) Use tee hanger inserts between adjacent flanges.
 - 2) Use thru-bolts and fish plates, except at roof deck without concrete fill.
 - b. Existing Construction:
 - 1) Use anchoring devices installed in webs of tees. Install anchoring devices as high as possible in the webs.
 - c. Do not use powder driven fasteners.
 - d. Exercise extreme care in drilling holes to avoid damage to reinforcement.
9. Attachment to Wood Construction: Use side beam brackets fastened to the sides of wood members to make attachments for hangers.
 - a. Under 15 lbs Load: Attach side beam brackets to wood members with two (2) No. 18 x 1-1/2" long wood screws, or two (2) No. 16 x 1-1/2" long drive screws.
 - b. Over 15 lbs Load: Attach side beam brackets to wood members with bolts and nuts or lag bolts. Do not use lag bolts in wooden members having a nominal thickness (beam face) under two (2) inches in size. Install bolts and nuts or lag bolts in the side of wood members at the mid-point of slightly above. Install plain washers under all nuts.
 - 1) 15-30 lb load: 3/8" x 1-3/4" lag bolts or 3/8" diameter bolts.
 - 2) 31-50 lb load: 1/2" x 2" lag bolts or 1/2" diameter bolts.
 - 3) Over 50 lb load (to load limit of structure): 5/8" diameter bolts.
 - c. Bottom chord of wood trusses may be utilized as structural support, but method of attachment must be specifically approved.
 - d. Do not make attachments to the diagonal or vertical members of wood trusses.
 - e. Do not make attachments to the nailing strips on top of steel beams.
10. Attachment to Metal Stud Construction: Use supporting fasteners manufactured specifically for the attachment of raceways and boxes to metal stud construction.
 - a. Support and attach outlet boxes so that they cannot torque/twist by using one of the following:
 - 1) Bar hanger assembly.
 - 2) Box hanger with far side support.
 - 3) Between stud mounting bracket.

3.4 CONDUIT SUPPORT SCHEDULE

- A. Provide number of supports as required by National Electrical Code. Exception: Maximum support spacing allowed is 4'-0" for conduit sizes 3 inches and larger supported from wood trusses.
- B. Use pipe straps and specified method of attachment where conduit is installed proximate to surface of wood or masonry construction.
 1. Use hangers secured to surface with specified method of attachment where conduit is suspended from the surface.
- C. Use "C" beam clamps and hangers where conduit is supported from steel beams.
- D. Use deck clamps and hangers where conduit is supported from steel decking having hanger tabs.
 1. Where conduit is supported from steel decking that does not have hanger tabs, use

clamps and hangers secured to decking, utilizing specified method of attachment.

- E. Use channel support system supported from structural steel for multiple parallel conduit runs.
- F. Where conduits are installed above ceiling, do not rest conduit directly on runner bars, T-Bars, etc.
 - 1. Conduit Sizes 2-1/2 Inches and Smaller: Support conduit from ceiling supports or from construction above ceiling.
 - 2. Conduit Sizes Over 2-1/2 Inches: Support conduit from concrete deck, beams, joists, or trusses above ceiling.

3.5 LIGHTING FIXTURE SUPPORT SCHEDULE

- A. General: Do not support fixtures from ceilings or ceiling supports unless it is specified or indicated on the drawings to do so.
 - 1. Support fixtures with hanger rods attached to beams, joists, or trusses. Hanger rod diameter, largest standard size that will fit in mounting holes of fixture.
 - a. Where approved, channel supports may span and rest upon the lower chord of trusses and be utilized for the support of lighting fixtures.
 - b. Where approved, channel supports may span and be attached to the underside of beams, joists, or trusses and be utilized for the support of lighting fixtures.
 - 2. Use two (2) nuts and two (2) washers on lower end of each hanger rod to hold and adjust fixture (one (1) nut and washer above top of fixture housing, one (1) nut and washer below top of fixture housing).
 - a. Where specified that an adequately supported outlet box is to support a fixture or be utilized as one (1) point of support, support the box so that it may be adjusted to bring the face of the outlet box even with surface of ceiling
- B. Specific Installations Where Fixtures May Be Supported From New Ceilings Being Installed by the General Contractor:
 - 1. Support surface mounted fixtures directly from plywood backed gypsum board ceilings.
 - 2. Support surface mounted fixtures directly from framing or furring members of fire rated suspended ceilings (double gypsum board).
 - 3. Support recessed mounted fixtures directly from furring members of furred gypsum board ceilings.
 - 4. Support recessed mounted fixtures directly from the suspension system of suspended acoustical ceilings. Exception: Support each fixture weighing more than 50 pounds independent of the suspended ceiling grid.
 - 5. Deliver documents that state actual fixture weights and indicate fixture locations to the General Contractor.
- C. Number of Supports for Ceiling Mounted Lighting Fixtures: Provide at least the following number of supports. Provide additional supports when recommended by fixture manufacturer, or shown on the drawings.

1. Commercial and Industrial LED Fixtures:
 - a. Support individual fixtures less than two (2) feet wide at two (2) points.
 - b. Support continuous row fixtures less than two (2) feet wide at points equal to the number of fixtures plus one (1). Uniformly distribute the points of support over the row of fixtures.
 - c. Support individual fixtures two (2) feet or wider at four (4) corners.
 - d. Support continuous row fixtures two (2) feet or wider at points equal to twice the number of fixtures plus two (2). Uniformly distribute the points of support over the row of fixtures.
 - e. An adequately supported outlet box may be utilized as one point of support for fixtures weighing less than 50 pounds.

- D. Number of Supports for Wall Mounted Lighting Fixtures: Provide at least the following number of supports. Provide additional supports when recommended by fixture manufacturer, or shown on the drawings.
 1. Commercial and Industrial LED Fixtures:
 - a. Support individual fixtures two (2) feet long or less at two (2) points.
 - b. Support individual fixtures over two (2) feet long at three (3) points.
 - c. Support continuous row fixtures at points equal to twice the number of fixtures. Uniformly distribute the points of support.
 - d. An adequately supported outlet box may be utilized as one (1) point of support for fixtures weighing less than 50 pounds.

 2. Vandal Resistant and Minimum Security LED Fixtures:
 - a. Support individual fixtures two (2) feet long or less at minimum of four (4) points (each corner).
 - b. Support individual fixtures over two (2) feet long, to three (3) feet long, at minimum of six (6) points (each corner and midway along each side of longest axis).
 - c. Support continuous row fixtures at points equal to six (6) times the number of fixtures. Uniformly distribute the points of support.
 - d. An adequately supported outlet box may be utilized as one (1) point of support for fixtures weighing less than 50 pounds.

3.6 CHANNEL SUPPORT SYSTEM SCHEDULE

- A. Use channel support system where specified or indicated on the drawings.
- B. Channel supports may be used, as approved, to accommodate mounting of equipment.
- C. Material and Finish:
 1. Dry Locations: Use 12 gauge steel channel support system having any one of the specified finishes.
 2. Damp Locations: Use 12 gauge steel channel support system having any one of the specified finishes except green epoxy/enamel.
 3. Wet locations: Use 12 gauge steel channel support system having hot dipped galvanized, or PVC finish.

3.7 ROOFTOP SUPPORT SYSTEM

- A. Install in accordance with manufacturer's instructions and recommendations.
- B. Provide complete and adequate support of all conduit, cable tray, or equipment.
- C. The use of wood blocks for supporting conduit, cable tray, or equipment is not permitted.
- D. If gravel top roof, gravel must be removed around and under support.
- E. Consult roofing manufacturer for roof membrane compression capacities. If necessary, a compatible sheet of roofing material (isolation pad) may be installed under rooftop support to disperse concentrated loads and add further membrane protection.
- F. Use properly sized clamps to secure conduit, cable tray, or equipment.

END OF SECTION

SECTION 26 0533 – RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the following conduits, surface raceways, multi-outlet assemblies, auxiliary gutters, wall duct, and boxes for electrical systems including wall and ceiling outlet boxes, floor boxes, and junction boxes.

1.2 REFERENCES

- A. Applicable provisions of Division 1 govern work under this section.
- B. Section 260529 – Hangers and Supports.
- C. Section 262726 – Wiring Devices.
- D. Section 262702 – Equipment Wiring.
- E. Section 270000 – Communications Cable and Equipment.
- F. Section 283100 – Fire Detection and Alarm.

PART 2 - PRODUCTS

2.1 RIGID METAL CONDUIT AND FITTINGS

- A. Conduit: Heavy wall, galvanized steel, schedule 40, threaded.
- B. Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

2.2 INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS

- A. Conduit: Galvanized steel, threaded.
- B. Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

2.3 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

- A. Conduit: Steel, galvanized tubing.
- B. Fittings:
 - 1. All steel, set screw, concrete tight. No push-on or indenter types permitted.
 - 2. Raintight Fittings:
 - a. All steel construction with zinc electroplate finish provides for durable corrosion resistance
 - b. Distinct color to provide quick raintight identification

- c. Integral gasketed compression ring secures and seals for reliable installation
- d. Gasket on male threads of box connector seals installation for raintight connection between the box and the connector

C. Conduit Bodies: All steel threaded conduit bodies.

2.4 FLEXIBLE METAL CONDUIT AND FITTINGS

- A. Conduit: steel, galvanized, spiral strip.
- B. Fittings and Conduit Bodies: All steel, galvanized, or malleable iron (except as allowed in Specification 265113).

2.5 RIGID NONMETALLIC CONDUIT AND FITTINGS

- A. Conduit: Schedule 40 PVC minimum, Listed, sunlight resistant, rated for 90° C conductors.
- B. Fittings and Conduit Bodies: NEMA TC 2, Listed.

2.6 CONDUIT SUPPORTS

- A. See Section 260529.

2.7 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: galvanized steel, with stamped knockouts.
- B. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 3/8 inch male fixture studs where required.
- C. Concrete Ceiling Boxes: Concrete type.
- D. Cast Boxes: Cast ferroalloy, or aluminum type deep type, gasketed cover, threaded hubs.

2.8 FLOOR BOXES

- A. Floor Boxes for Installation in Cast-In-Place Concrete Floors: Full adjustable.
- B. Formed steel boxes in slab-on-grade applications shall be epoxy coated.

2.9 PULL AND JUNCTION BOXES

- A. Pull boxes and junction boxes shall be minimum 4 inch square by 2 1/8th inches deep for use with 1 inch conduit and smaller. On conduit systems using 1 1/4 inch conduit or larger, pull and junction boxes shall be sized per NEC but not less than 4 11/16 inch square.
- B. For telecommunication, fiber optic, security, and other low voltage cable installations the NEC box size requirements shall apply. All boxes, used on telecommunication, security, other low voltage and fiber optic systems with conduits of 1 1/4" and larger, shall be sized per the NEC conduit requirements. For determining box size, the conduit is the determining factor not the wire size.

- C. Sheet Metal Boxes: code gauge galvanized steel, screw covers, flanged and spot welded joints and corners.
- D. Sheet metal boxes larger than twenty-four (24) inches in any dimension shall have a hinged cover or a chain installed between box and cover.
- E. Cast Metal Boxes for Outdoor and Wet Location Installations: Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron or aluminum box and cover with ground flange, neoprene gasket, and stainless steel cover screws.
- F. Fiberglass or Concrete Handholes:
 - 1. With weatherproof cover of non-skid finish shall be used for underground installations.
 - 2. Size, type, weight rating, and labeling shall be as noted on the drawings.
- G. The use of box extension rings is discouraged. If they must be used only one ring per box is allowed and wiring must extend a minimum of 6" beyond the front edge of the extension ring.
- H. Box extensions and adjacent boxes within 48" of each other are not allowed for the purpose of creating more wire capacity.
- I. Junction boxes 6" x 6" or larger size shall be without stamped knock-outs.
- J. Wireways shall not be used in lieu of junction boxes.

2.10 GENERAL

- A. All steel fittings and conduit bodies shall be galvanized.
- B. No cast metal or split-gland type fittings permitted.
- C. Mogul-type condulets larger than two inches (2") not permitted except as approved or detailed.
- D. All condulet covers must be fastened to the condulet body with screws and be of the same manufacture.
- E. Wireways, gutters and c-condulets shall not be used in lieu of pull boxes and condulets.
- F. All boxes shall be of sufficient size to provide free space for all conductors enclosed in the box and shall comply with NEC requirements.

PART 3 - EXECUTION

3.1 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT

- A. EMT is permitted to be used in sizes 4" and smaller for power and telecommunication systems. See CONDUIT INSTALLATION SCHEDULE below for other limitations for EMT and other types of conduit.
- B. Size power conductor raceways for conductor type installed. Conduit size shall be 1/2 inch minimum except all homerun conduits shall be 3/4", or as specified elsewhere. Caution: Per the NEC, the allowable conductor ampacity is reduced when more than three (3) current-carrying

conductors are installed in a raceway. Contractor must take the NEC ampacity adjustment factors into account when sizing the raceway and wiring system.

- C. Size conduit for all other wiring, including but not limited to data, control, security, fire alarm, telecommunications, signal, video, etc. shall be sized per number of conductors pulled and their cross-section. 40% fill shall be maximum for all new conduit fills.
- D. Arrange conduit to maintain headroom and present a neat appearance.
- E. Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.
- F. Maintain minimum six (6) inch clearance between conduit and piping. Maintain twelve (12) inch clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.
- G. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized pipe straps, conduit racks (lay-in adjustable hangers), clevis hangers, or bolted split stamped galvanized hangers.
- H. Group conduit in parallel runs where practical and use conduit rack (lay-in adjustable hangers) constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.
- I. Do not fasten conduit with wire or perforated pipe straps. Before conductors are pulled, remove all wire used for temporary conduit support during construction.
- J. Support and fasten metal conduit at a maximum of eight (8) feet on center.
- K. Supports shall be independent of the installations of other trades, e.g. ceiling support wires, HVAC pipes, other conduits, etc., unless so approved or detailed.
- L. In general, all conduits shall be concealed except where noted on the drawings or approved by the Architect/Engineer. Contractor shall verify with Architect/Engineer all surface conduit installations except in mechanical, electrical or utility rooms that are not occupied spaces.
- M. Changes in direction shall be made with symmetrical bends, cast steel boxes, stamped metal boxes or cast steel conduit bodies.
- N. For indoor conduits, no continuous conduit run shall exceed 100 feet without a junction box.
- O. All conduits installed in exposed areas shall be installed with a box offset before entering box.

3.2 CONDUIT INSTALLATION

- A. Cut conduit square; de-burr cut ends.
- B. Conduit shall not be fastened to the corrugated metal roof deck. Maintain a minimum six (6) inch separation from the roof deck to conduits.
- C. Bring conduit to the shoulder of fittings and couplings and fasten securely.
- D. Use conduit hubs for fastening conduit to cast boxes. Use sealing locknuts or conduit hubs for fastening conduit to sheet metal boxes in damp or wet locations.

- E. All conduit terminations (except for terminations into conduit bodies) shall use conduit hubs, or connectors with one (1) locknut, or shall use double locknuts (one (1) each side of box wall) and insulated bushing. Provide bushings for the ends of all conduit not terminated in box walls. Refer to Section 260526 – Grounding and Bonding for Electrical Systems for grounding bushing requirements.
- F. Install no more than the equivalent of four (4) 90 degree bends between boxes.
- G. Use hydraulic one (1)-shot conduit bender or factory elbows for bends in conduit larger than two (2) inch size unless sweep elbows are required.
- H. Conduit shall be bent according to manufacturers' recommendations. Torches or open flame shall not be used to aid in bend of PVC conduit.
- I. Use suitable conduit caps or other approved seals to protect installed conduit against entrance of dirt and moisture.
- J. Provide 1/8 inch nylon pull string in empty conduit, except sleeves and nipples.
- K. Install expansion-deflection joints where conduit crosses building expansion joints. Note: expansion-deflection joints are not required where conduit crosses building control joints if the control joint does not act as an expansion joint. Install expansion fitting in PVC conduit runs as recommended by the manufacturer.
- L. Avoid moisture traps where possible. Where moisture traps are unavoidable, provide junction boxes with drain fittings at conduit low points.
- M. Where conduit passes between areas of differing temperatures such as into or out of unheated and heated spaces, buildings, etc., provide Listed conduit seals to prevent the passage of moisture and water vapor through the conduit.
- N. Route conduit through roof openings for piping and ductwork where possible.
- O. Conduit is not permitted in any slab topping of two inches or less. Consult Structural Engineer for approval of conduit installed in topping slabs greater than two inches.
- P. Maximum Size Conduit in Slabs Above Grade: 3/4 inch. Do not route conduits to cross each other in slabs above grade.
- Q. PVC conduit shall transition to galvanized rigid metal conduit before it enters a concrete pole base, foundation, wall (where exposed) or up through a concrete floor.
- R. All conduit installed underground (exterior to building) shall be buried a minimum of 24" below finished grade, whether or not the conduit is concrete encased.
 - 1. All underground conduits shall be installed with "DANGER – BURIED ELECTRICAL CONDUIT" red flagging tape 6-inches above conduit. Tape shall be continuous along the conduit run.
 - 2. Tracer wire shall be installed on all exterior electrical utilities. Trace wire to be fourteen (14) gauge minimum solid copper with thermoplastic insulation recommended for direct burial. Wire connectors to be 3M DBR, or approved equal, and shall be watertight to provide electrical continuity. Install trace wire in the same trench with the conduit during installation and secure to conduit as required to ensure that the wire remains adjacent to the conduit. Trace wire access points shall in general be no more than 500' apart.

- S. PVC conduit shall be cleaned with solvent, and dried before application of glue. The temperature rating of glue/cement shall match weather condition. Apply full even coat of cement/glue to entire area that will be inserted into fitting. The entire installation shall meet manufacturers' recommendations.

3.3 CONDUIT INSTALLATION SCHEDULE

- A. Conduit other than that specified below for specific applications shall not be used.
- B. Conduit in patient care areas shall be metallic to maintain dual ground paths as required by the NEC.
- C. Underground Installations Within Five Feet of Foundation Wall: Rigid steel conduit.
- D. Underground Installations More than Five Feet From Foundation Wall: Schedule 40 PVC conduit.
- E. Directional Boring: HDPE conduit.
- F. Under Slab on Grade Installations: Schedule 40 PVC conduit.
- G. Exposed Outdoor Locations: Rigid steel conduit
- H. Concealed in Concrete and Block Walls: Electrical metallic tubing.
- I. Within Concrete Slab: Schedule 40 PVC conduit.
- J. Wet Interior Locations: Rigid steel conduit.
- K. Concealed Dry Interior Locations: Electrical metallic tubing.
- L. Exposed Dry Interior Locations: Electrical metallic tubing.
- M. Motor and equipment connections: Flexible metal conduit (all locations). Minimum length shall be one foot, maximum length shall be three feet. Conduit must be installed perpendicular to direction of equipment vibration to allow conduit to freely flex.
- N. Light fixtures: Direct box or conduit connection for surface mounted and recessed fixtures. Flexible metal conduit from a J-box for recessed lay-in light fixtures. Conduit size shall be 3/8" minimum diameter and six (6) foot maximum length. Conduit length shall allow movement of fixture for maintenance purposes.
- O. Medium Voltage Applications (Interior Locations): Rigid steel conduit.

3.4 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.
- B. Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.
- C. No outlet, junction, or pull boxes shall be located where it will be obstructed by other equipment, piping, lockers, benches, counters, etc.

- D. Boxes shall not be fastened to the metal roof deck. Maintain a minimum six (6) inch separation from the roof deck to boxes.
- E. It shall be the Contractor's responsibility to study drawings pertaining to other trades, to discuss location of outlets with workmen installing other piping and equipment and to fit all electrical outlets to job conditions.
- F. In case of any question over the location of an outlet, the Contractor shall refer the matter to the Architect/Engineer and install outlet as instructed by the Architect/Engineer.
- G. The proper location of each outlet is considered a part of this contract and no additional compensation will be paid to the Contractor for moving outlets which were improperly located.
- H. Locate and install boxes to allow access to them. Where installation is inaccessible, coordinate locations and provide 18 inch by 24 inch access doors.
- I. Locate and install to maintain headroom and to present a neat appearance.
- J. Install boxes to preserve fire resistance rating of partitions and other elements, using approved materials and methods.
- K. Install boxes to preserve room acoustic ratings using approved material and methods.
- L. Boxes mounted in common walls of adjacent rooms shall be offset by at least one stud space to minimize sound transference between rooms. If space does not allow for offsetting of boxes for adjacent rooms by one stud cavity, sound dampening material such as sound batting shall be installed around and between boxes.

3.5 OUTLET BOX INSTALLATION

- A. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. The front edge of the box, plaster ring, extension ring, or listed extender shall not be set back of the finished wall surface more than 1/4" in accordance with NEC 314.20. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
- B. Do not install boxes back-to-back in walls. Provide minimum 6 inch separation, except provide minimum 24 inch separation in acoustic-rated walls.
- C. Power
 - 1. Recessed (1/4" maximum) outlet boxes in masonry, concrete or tile construction shall be minimum 4-inch square, with device rings. Device covers shall be square-cut except rounded corner plaster rings are allowed in drywall applications. Angle cut plaster rings are not permitted. Coordinate masonry cutting to achieve neat openings for boxes.
- D. Low Voltage
 - 1. Recessed (1/4" maximum) outlet boxes in masonry, concrete or tile construction shall be minimum 4-11/16" square, 2-1/8" deep. Device covers shall be square-cut except rounded corner plaster rings are allowed in drywall applications. Angle cut plaster rings are not permitted. Coordinate masonry cutting to achieve neat openings for boxes.
- E. Provide knockout closures for unused openings.

- F. Support boxes independently of conduit except for cast boxes that are connected to two (2) rigid metal conduits, both supported within twelve (12) inches of box.
- G. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide non-metallic barriers to separate wiring of different voltage systems.
- H. Install boxes in walls without damaging wall insulation.
- I. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- J. Ceiling outlets shall be four (4) inch square, minimum 2-1/8 inch deep except that concrete boxes and plates will be approved where applicable. Position outlets to locate luminaires as shown on reflected ceiling plans.
- K. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.
- L. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
- M. Provide cast ferroalloy or aluminum outlet boxes in exterior and wet locations.
- N. Surface wall outlets shall be four (4) inch square with raised covers for one (1) and two (2) gang requirements. For three (3) gang or larger requirements, use gang boxes with non-overlapping covers.

3.6 FLOOR BOX INSTALLATION

- A. Set boxes level and flush with finish flooring material and parallel to the walls of the room.

3.7 PULL AND JUNCTION BOX INSTALLATION

- A. Locate pull boxes and junction boxes above accessible ceilings, in unfinished areas or furnish and install access panels in non-accessible ceilings where boxes are installed. All boxes are to be readily-accessible.
- B. Support pull and junction boxes independent of conduit.

END OF SECTION

SECTION 26 0553 - IDENTIFICATION

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the labeling of power, lighting, general wiring, signal, fire alarm, and cabling.

1.2 REFERENCES

- A. Applicable provisions of Division 1 shall govern work under this section.
- B. Section 260519 – Low Voltage Electrical Power Conductors and Cables
- C. Section 260523 – Control Cables
- D. Section 271010 – Telecommunication Cabling Systems

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Labels: All labels shall be permanent, and machine generated. NO HANDWRITTEN OR NON-PERMANENT LABELS ARE ALLOWED. Exception: Back side of device plates and junction boxes may use handwritten, legible labeling on box covers, unless specifically prohibited by other specification sections.
- B. Cable label size shall be appropriate for the conductor or cable size(s), outlet faceplate layout and patch panel design. All labels shall be self-laminating, white/transparent vinyl and be wrapped around the cable or sheath. Labels for power conductors (600V and lower) shall be cloth-type. Flag type labels are not allowed. The labels shall be of adequate size to accommodate the circumference of the cable being labeled and properly self-laminate over the full extent of the printed area of the label.
- C. Nameplates: Engraved three-layer laminated plastic, white letters on a black background. Emergency system (Level 1 and Level 2) shall use white letters on red background.
- D. Tape (phase identification only): Scotch #35 tape in appropriate colors for system voltage and phase.
- E. Adhesive type labels not permitted except for phase and wire identification. Machine generated adhesive labels shall be permitted for device plates, 4-11/16" and smaller junction boxes, fire alarm and control devices.

PART 3 - EXECUTION

3.1 GENERAL

- A. Where mixed voltages are used in one building (e.g. 480 volt, 208 volt) each switch,

switchboard, junction box, equipment, etc., on each system must be labeled for voltage in addition to other requirements listed herein.

- B. All branch circuit and power panels must be identified with the same symbol used in circuit directory in main distribution center.
- C. Clean all surfaces before attaching labels with the label manufacturer's recommended cleaning agent.
- D. Install all labels firmly as recommended by the label manufacturer.
- E. Labels shall be installed plumb and neatly on all equipment.
- F. Install nameplates parallel to equipment lines.
- G. Secure nameplates to equipment fronts using screws, rivets or manufacturer approved adhesive or cement.
- H. Embossed tape will not be permitted for any application.

3.2 JUNCTION AND PULLBOX IDENTIFICATION

- A. Provide circuit numbers, and source panel designations for power wiring. Other system shall be identified as shown on details or approved shop drawings. Temperature control shall identify the source.

3.3 POWER AND CONTROL WIRE IDENTIFICATION

- A. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams or equipment manufacturer's shop drawings for control wiring.
- B. All wiring shall be labeled within 2 to 4 inches of terminations. Each end of a wire or cable shall be labeled as soon as it is terminated including wiring used for temporary purposes.

3.4 WIRING DEVICE IDENTIFICATION

- A. Wall switches, line voltage wall dimmers, motor switches, receptacles (interior, exterior, floor boxes, etc.), photocells and time clocks shall be identified with circuit numbers and source. Labeling shall be permanent and machine generated. Label shall have 1/4" black text on a clear label. Label shall be installed at consistent location on the face of the device cover plate.
- B. Wall switches, line voltage wall dimmers, motor switches, receptacles (interior, exterior, floor boxes, etc.), photocells and time clocks shall be identified with circuit numbers and source. Labeling shall be permanent and machine generated (1/4" black text on a clear label) or neatly hand-written permanent marker. Label shall be installed on the inside of the device cover plate.

3.5 NAMEPLATE ENGRAVING

- A. Provide nameplates of minimum letter height as scheduled below.

- B. Panelboards, Switchboards and Motor Control Centers: 1 inch; identify equipment designation. 1/2 inch; identify voltage rating, source and room location of the source.
- C. Equipment Enclosures: 1 inch; identify equipment designation. 1/2 inch; identify voltage rating, source and room location of the source where applicable.
- D. Circuit Breakers, Switches, and Motor Starters/VFD's in Panelboards or Switchboards or Motor Control Centers: 1/2 inch; identify circuit and load served, including location.
- E. Individual Circuit Breakers, Disconnect Switches, Enclosed Switches, Motor Starters, and VFD's: 1/2 inch; identify source and load served.
- F. Transformers: 1 inch; identify equipment designation. 1/2 inch; identify primary and secondary voltages, primary source, and secondary load and location.
- G. Junction boxes: 1 inch; identify system source(s) and load(s) served. Junction boxes may be neatly identified using a permanent marker.

3.6 PANELBOARD DIRECTORIES

- A. Typed directories for panels must be covered with clear plastic, have a metal frame. Room number on directories shall be Owner's numbers, not Plan numbers unless Owner so specifies.

3.7 ARC FLASH LABELS

- A. Install ARC FLASH WARNING signs on all switchboards, panelboards, and motor control centers.

3.8 FIRE ALARM DEVICES

- A. Install computer printed labels on all addressable fire alarm devices indicating the device loop and address. Label shall have 1/4" black text on a clear label.
 - 1. Coordinate label location on devices with the Owner prior to installation.

END OF SECTION

SECTION 26 0925 – OCCUPANCY SENSORS FOR LIGHTING CONTROL

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the following occupancy sensors for lighting control and building automation interface (where noted) indicated by the Contract Documents with supplementary items necessary for proper installation.

1.2 REFERENCES

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

1.3 SUBMITTALS

- A. Submit product data under provisions of specification section 260500 Common Work Results.
- B. Product Data: For each type of product indicated.
- C. Submit a lighting plan clearly marked by manufacturer showing proper product, location, and orientation of each sensor. Sensor quantity, location, and aiming shall be determined by the manufacturer based on 100% coverage of the spaces. Device locations shown on the plans are for basis of design only and shall not be used for submittals.

1.4 CLOSEOUT SUBMITTALS

- A. Operating and maintenance instructions.
- B. Record drawings of network system. Show physical routing of cables and location of system devices.
- C. Cable testing documentation for CAT5/CAT5E/CAT6 field terminated cabling.

1.5 QUALITY ASSURANCE

- A. Products supplied shall be from a single manufacturer that has been continuously involved in manufacturing of occupancy sensors for a minimum of five (5) years. Mixing of manufacturers shall not be allowed.
- B. All components shall be U.L. listed and meet all state and local applicable code requirements.
- C. Wall switch products must be capable of withstanding the effects of inrush current. Submittals shall clearly indicate the method used.

1.6 SUMMARY

- A. Contractor's work to include all labor, materials, tools, appliances, control hardware, sensor, wire, junction boxes and equipment necessary for and incidental to the delivery, installation and

furnishing of a completely operational occupancy sensor lighting control system, as described herein.

- B. Contractor/Supplier shall examine all general specification provisions and drawings for related electrical work required as work under Division 26.
- C. Contractor shall coordinate all work described in this section with all other applicable plans and specifications, including but not limited to wiring, conduit, fixtures, HVAC systems and building management systems.
- D. The occupancy sensor based lighting control shall accommodate all conditions of space utilization and all irregular work hours and habits
- E. Contractor, in accordance with manufacturer's recommendation, shall determine final sensor location.
- F. All applicable products must be UL Listed or other acceptable national testing organization.

1.7 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section general requirements.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site. Store and protect under provisions of specification section 260500 Common Work Results.

1.9 WARRANTY

- A. Products shall carry a five (5)-year warranty.

PART 2 - PRODUCTS

2.1 AVAILABLE MANUFACTURERS

- A. Refer to plans for acceptable manufacturer.

2.2 GENERAL WALL SWITCH SENSOR REQUIREMENTS

- A. Wall switch sensor shall recess into single gang switch box and fit a standard GFI opening.
- B. Sensor must meet NEC grounding requirements by providing a dedicated ground connection and grounding to mounting strap. Line and load wire connections shall be interchangeable. Sensor shall not allow current to pass to the load when sensor is in the unoccupied (Off) condition.
- C. Wall switch sensor with built-in override control (off-auto). Furnish the model which suits the electrical system parameters, and accommodates the square footage coverage and wattage requirement for each area (and type of lighting) controlled.

- D. Wall switch products shall utilize Zero Crossing Circuitry which increases relay life, protects from the effects of inrush current, and increases sensor's longevity.
- E. Where specified, wall switch sensors shall provide a field selectable option to convert sensor operation from automatic-ON to manual-ON.
- F. All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems and rated motor loads
- G. In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.
- H. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.
- I. Where specified, sensor shall have an additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options.
- J. In areas with inboard/outboard switching, sensor shall provide two (2) dedicated relays and override switches.

2.3 INFRARED WALL SWITCH SENSORS

- A. Passive infrared sensors shall utilize detection technology to respond only to those signals caused by human motion
- B. Passive infrared sensors shall provide high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line).
- C. Where specified, passive infrared ultrasonic and dual technology sensors shall offer daylighting footcandle adjustment control and be able to accommodate dual level lighting.

2.4 ULTRASONIC/ACOUSTIC WALL SWITCH SENSORS

- A. Ultrasonic/acoustic sensors shall utilize signal processing to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout the controlled space.

2.5 DUAL TECHNOLOGY WALL SWITCH SENSORS

- A. Dual technology sensors shall consist of passive infrared and ultrasonic and/or acoustic technologies for occupancy detection.
- B. Where specified, sensors shall offer daylighting footcandle adjustment control and be able to accommodate dual level lighting.

2.6 PIR TYPE

- A. Ceiling mounting; Detect occupancy by sensing a combination of heat and movement in area of coverage.

2.7 ULTRASONIC/ACOUSTIC TYPE

- A. Ceiling mounting; Detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage or by changes in sound levels.

2.8 DUAL-TECHNOLOGY TYPE

- A. Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic and/or acoustic detection methods in area of coverage. Particular technology or combination of technologies that controls on and off functions shall be selectable in the field by operating controls on unit.

2.9 LOW VOLTAGE SENSORS

- A. Sensors shall operate on a Class II, three-conductor system. Sensors shall operate on 12 to 24 VAC or VDC.
- B. Upon initial power up, sensors must immediately turn on. Power packs may be wired on the line or load side of local switching and must not exhibit any delays when switch is energized.
- C. Optional interface with Building Automation System (BAS): Each zone designated shall provide one sensor with a SPDT Class II relay providing a digital input to BAS. All sensors in designated zone shall communicate to sensor with relay for status to BAS. Sensor relay coil shall energize in the unoccupied state to load share the low voltage current from power pack. Note that Power Pack must be installed on the Line side of the local toggle switch for Relay to work properly.
- D. In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.
- E. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.
- F. Sensor shall be wall or ceiling mounted as shown on the plans. Provide mounting hardware suitable for specified mounting location.

2.10 POWER PACKS

- A. Power packs shall accept 120 or 277 VAC, be plenum rated, and provide Class II power for remote sensors. Control wiring between sensors and power packs shall be Class II, 18-24 AWG, stranded, U.L. Listed, PVC insulated or TEFLON jacketed cable suitable for use in plenums, where applicable.
- B. Relay contacts shall have ratings of:
 - 1. 13A for 120 VAC tungsten loads
 - 2. 20A for 120 VAC ballast loads
 - 3. 20A for 277 VAC ballast loads
- C. For ease of mounting, installation and future service, power pack(s) shall be able to externally mount through a 1/2" knock-out on a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay(s) and a

transformer to provide low-voltage power. Control unit shall provide power to a minimum of two (2) sensors.

- D. When required by local code, power pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.
- E. Power packs shall be single circuit, or two (2) circuits. Slave Packs may be used to control additional circuits. When two circuit power packs, or slave packs are used, the power packs must be wired directly to circuit breaker. Otherwise, power packs may be wired on the line or load side of the local switch.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. It shall be the contractor's responsibility to locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Rooms shall have ninety (90) to one hundred (100) percent coverage (minor motion in office environments) to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The contractor shall provide additional sensors if required to properly and completely cover the respective room.
- B. It is the contractor's responsibility to arrange a pre-installation meeting with manufacturer's factory authorized representative, at Owner's facility, to verify placement of sensors and installation criteria
- C. Proper judgment must be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components. The contractor shall also provide, at the Owner's facility, the training necessary to familiarize the Owner's personnel with the operation, use, adjustment, and problem solving diagnosis of the occupancy sensing devices and systems.
- D. Ceiling sensors shall not be installed within six (6) – eight (8) feet of HVAC outlets or heating blowers.
- E. Power packs and relays shall be installed at accessible locations. Coordinate installation with other systems and architectural ceilings to determine final power pack and relay locations.

3.2 WIRING

- A. All control wiring should be installed and terminated by a qualified installer and should follow standard wiring installation practices.
- B. Provide wiring types as noted in the shop drawings or manufacturer's literature.
- C. Provide a minimum 6' service loop in the cable at the ceiling sensor location to allow for sensor relocation if necessary.

- D. Sensors and devices that employ the use of CAT5/CAT5E/CAT6 cabling shall use factory terminated cables or field terminated cables for interconnectivity. All field terminated cables shall be labeled and tested prior to installation.

3.3 FIELD QUALITY CONTROL

- A. Where applicable, adjust sensitivity so that controlled area is lighted when area is occupied.
- B. Adjust time delay so that controlled area remains lighted for five (5) minutes after occupant leaves area. Coordinate with the Owner for different time delay settings to meet specific room requirements.
- C. For sensors that are equipped with light level sensors, adjust light level setting so that lights are off when there is sufficient natural light.

END OF SECTION

SECTION 26 0943 - DIGITAL LIGHTING CONTROLS

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all work required to provide and install the lighting control components, conductors, cabling and raceways to form a distributed-type digital lighting control system. The lighting control system shall provide time-based, sensor-based (occupancy and/or daylight) and manual lighting controls, as indicated on plans and schedules.
- B. Section includes:
 - 1. Zone controllers
 - 2. Manual controls
 - 3. Digital occupancy sensors
 - 4. Digital photo sensors
 - 5. Programming tools
 - 6. Accessories
 - 7. Wiring

1.2 REFERENCES

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to this Section.
- B. Specification 260923 Lighting Control Devices
- C. Specification 260519 Low-Voltage Electrical Power Conductors and Cables
- D. Specification 260523 Control Cables
- E. Refer to Digital Lighting Controls Schedule, Digital Lighting Controls - Zone Control Schedule and Digital Lighting Controls - Switch Schedule on plans.

1.3 SUBMITTALS

- A. Product data: Provide a detailed cut sheet with model number(s) and included options clearly noted for each system component type, except cabling. Indicate dimensions.
- B. Shop drawings:
 - 1. CAD drawings:
 - a. Selected manufacturer shall request CAD floor plans from the Engineer and layout all system devices on the CAD plan, except for cabling. A legend shall be

- provided on the CAD plan to aid in quick identification of each device and function of that device.
- b. For occupancy and photo sensors: Selected manufacturer shall review ceiling heights, room obstructions (e.g. ceiling fans) and room finishes shown on the architectural plans. Where a conflict arises between the design on plan and selected manufacturer's recommendations, the manufacturer's recommendation shall dictate the type and quantity of devices used in that space.
 - c. The locations and quantities of occupancy and photo sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with those sensors. The Contractor shall include in their bid the additional occupancy sensors needed to properly and completely cover the respective room.
- 2. One-line block diagram: Project specific with nomenclature matching plans. Show interconnections between components specified in this section and necessary system interfaces. Indicate required communication cabling types.
 - 3. Wiring diagrams: Power, signal, and control wiring. Coordinate nomenclature with block diagram.
 - 4. Custom button labels: Submit a custom button label form for each manual switch requiring custom labels.
- C. Warranties: Submit sample warranty letter meeting requirements specified in this section.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit under requirement and format listed in Specification 260500 Common Work Results
- B. Include the following additional documentation:
 - 1. Copy of on-site system startup reports.
 - 2. All required submittals for this section, updated to reflect required changes from review comments.
 - 3. System device addresses and programmed settings (e.g. an occupancy sensor time delay).
 - 4. Mark locations of zone controllers and interfaces on the as-built drawings.
 - 5. Warranty letter(s) indicating dates of coverage and warranty claim contact information.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Digital lighting control system components shall be sourced from a single manufacturer.
 - 1. Exception: Occupancy sensors and emergency relay devices, tested with and approved by the manufacturer of the selected digital lighting control system, may be from different manufacturer. However, all occupancy sensors (digital and analog) must be from the same manufacturer.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 DEFINITIONS

- A. BAS: Building automation system.
- B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling and power-limited circuits.
- C. RS-232: A serial network protocol complying with TIA/EIA-232.

1.7 PLAN NOTATION

- A. Luminaire zoning notation on plans:
 - 1. Basic room zoning
 - a. Rooms with Digital Lighting Control Devices ('L' subscript), but without luminaire subscripts indicates that room contains either one zone of dimmed control or two or fewer zones of switched control. The luminaire subscripts have been omitted to maintain drawing clarity.
 - 2. Complex room zoning
 - a. To better define zoning intent in areas containing two or more dimmed lighting zones or three or more switched lighting zones, luminaire subscripts (e.g. 'a1', 'a2', etc) have been shown next to each luminaire on plan.
 - b. Luminaires with matching subscripts shall be controlled together as one lighting control zone. A luminaire with two subscripts (e.g. 'a1,a2') indicates that luminaire belongs to two independent lighting control zones to allow for multi-level or step-dimming control.
- B. Manual controls
 - 1. Basic rooms: Switch breaks and line work shown on plans will identify control within the room.
 - 2. Complex rooms: Each low voltage manual switch (\$_{LV}) is assigned a unique three digit number (e.g. '001') on plan. Refer to the Digital Lighting Control - Switch Schedule on plans for quantity of buttons, control type and zones controlled. Switch breaks have been omitted from the plans for these types of rooms.
- C. Digital occupancy sensors
 - 1. Digital occupancy sensors intended to be part of the digital lighting control system will have an 'L' subscript on plan.
 - 2. Basic rooms: All the luminaires in the room shall be controlled by the occupancy sensor(s) shown in that room. Subscripts indicating zones controlled have been omitted from the occupancy sensor.

3. Complex rooms: Subscripts of lighting zones controlled by each occupancy sensor will be indicated on plan below the occupancy sensor symbol (e.g. 'a1,a2'). Refer to Digital Lighting Controls – Zone Control Schedule on plan for additional information.

D. Digital photo sensors

1. Digital photo sensors intended to be part of the digital lighting control system will have an 'L__' subscript on plan. A ';' is used between groups of zones on plan to indicate multiple, separate zones are controlled using the input from this one device (e.g. 'a1-a4; a5').
2. Basic rooms: When a photo sensor is shown in a room containing luminaires without subscripts, all the luminaires in the room shall be controlled (i.e. switched or dimmed) by the photo sensor shown in that room as a common group. Subscripts indicating zones controlled have been omitted from the occupancy sensor.
3. Complex rooms: Subscripts of lighting zones controlled by each occupancy sensor will be indicated on plan below the photo sensor symbol (e.g. 'a1, a2'). Refer to Digital Lighting Controls – Zone Control Schedule on plan.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site. Store and protect under provisions of Specification 260500 General Work Results.

1.9 WARRANTY

- A. All equipment shall be warranted to be free of defects in materials and workmanship by the manufacturer for the period of five (5) years from the date of successful system startup.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Refer to Digital Lighting Control Schedule on plan.

2.2 ZONE CONTROLLERS

- A. Controls one or more luminaires in one or more independent lighting control zones. Contains one or more 20-amp, 120/277 volt relays in a plenum rated enclosure suitable for mounting to a junction box or luminaire. Also serves as a connection point for system peripheral devices (e.g. digital occupancy sensors, digital photo sensor, manual controls) serving room.
- B. Provide a zone controller with 0-10 VDC dimming when load(s) controlled are dimmable. Zone controllers ARE NOT shown on plans. Selected manufacturer shall provide in quantities as needed to meet zoning requirements shown on plans and schedules.

2.3 MANUAL CONTROLS

- A. Low voltage manual switches

1. Field-programmable, momentary-contact, plastic push buttons or rocker switches with LED light for each button indicating status. Provide remote interface and remote power supply, if necessary, for proper switch operation.
 2. Multiple switches shall be ganged together, if needed, to provide control indicated on plans at each manual control location.
 3. Non-\$_{LV} switches: Standard “ON”, “OFF”, “RAISE” or “▲”, and “LOWER” or “▼” labels are acceptable. Custom button labels are not required.
 4. \$_{LV} switches: Provide custom button labels as indicated on Digital Lighting Control System – Switch Schedule on plan.
- B. Refer to Digital Lighting Controls – Switch Schedule for button quantity, purpose and lighting zones controlled by each manual control.

2.5 DIGITAL OCCUPANCY SENSORS

- A. Device shall be designed for use with the digital lighting control system.
- B. Sensors to be low voltage devices and shall be powered from a zone controller.
- C. Provide with field-programmable time delay.
- D. Provide with an LED as a visual means that motion is being detected during both testing and normal operation.
- E. Provide mounting hardware suitable for specified mounting location.
- F. Refer to Digital Lighting Controls – Switch Schedule and floor plans for additional information.

2.6 DIGITAL PHOTO SENSORS

- A. Interior photo sensor: Ceiling mounted digital sensor that provides light level readings directly to the zone controller for automatic daylight harvesting. Powered by and connected to the zone controller.
- B. Skylight photo sensor: Photo sensing device specifically design for use in skylight sidewall connected to the network via suitable input module. Powered by and connected to the zone controller.
- C. Exterior photocell: Analog photo sensing device specifically designed for exterior use and connected to the system via a suitable interface module. Photocell to have weatherproof housing with visor for shading and lens protection. Adjustable light level sensitivity.
- D. Refer to Digital Lighting Controls – Switch Schedule and floor plans for additional information.

2.7 NETWORK COMPONENTS

- A. Network Bridges

1. Allows a zone controller and stand-alone system components to become part of a building-wide lighting control network. Converts communication via universal protocol (e.g. BACnet MS/TP) to system-specific protocol.
 2. Network bridges ARE NOT shown on plans. Provide in quantities as needed.
- B. Network segment manager:
1. Connects network bridges on the project to form a segment network. Allows for time-of-day and astronomical time clock scheduling of zones, plus monitoring and programming of all devices, including but not limited to digital occupancy sensors, digital daylight sensors and manual wall stations using any computer with internet access and a compatible web browser.
 2. Contains a web-browser user interface and connects to building network. Supports third party integration with BAS via BACnet IP.
 3. Network segment managers ARE NOT shown on plans.
- C. Network switches/routers: Allows for higher quantities of network devices for larger installations. Selected manufacturer to determine if quantity of devices shown plan requires this equipment. Network bridges ARE NOT shown on plans.
- D. Wireless network bridge: Allows for remote network lighting system components to be integrated into the overall lighting network (e.g. free-standing out-building). At a minimum, one wireless bridge is required in both the main building and the remote building. Network bridges ARE NOT shown on plans.
- E. Network devices above ARE NOT shown on plan. Provide components listed above in quantities as needed for a complete and functioning system.

2.8 PROGRAMMING TOOLS

- A. Wireless configuration tool: Handheld device with LCD that allows for configuration of all system devices, one at a time, via device infrared transceivers.
- B. Web-based programming: Provides connection via any internet-connected computer with username/password protection. Allows for multiple users at one time. No local software or user licenses required on the user's computer. Connects to user's local area network (LAN) or via the BAS (BACnet MS/TP protocol). GUI on website allows for programming and monitoring of all networked digital lighting control system components. Requires data connection to LAN with Ethernet static IP address, plus 120 volt receptacle.
- C. Programming tool IS NOT shown on plans. Furnish programming tool above for system programming.

2.9 ACCESSORIES

- B. Analog occupancy sensor interface: Allows for third-party and analog occupancy sensors to be connected into the digital lighting control system. Analog interfaces ARE NOT shown on plans.
- C. Emergency lighting control devices: Refer to Specification 265200 Emergency Lighting for requirements.

2.10 WIRING

- A. Line-voltage conductors: Comply with Specification 260519 Low-Voltage Electrical Power Conductors and Cables.
- B. Digital lighting control system cables: Comply with selected digital lighting control manufacturer's recommendations. All low voltage communication cabling shall be plenum rated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Zone controllers
 - 1. Rooms with accessible ceiling (e.g. lay-in grid): Install zone controller for each room above accessible ceiling directly above a manual control location. Mark location of zone controller on as-built drawing.
 - 2. Rooms with open ceilings: Install zone controller in adjacent room with accessible ceiling. Mark location of zone controller on as-built drawing.
 - a. Exception: Zone controllers for back-of-house rooms (e.g. storage room) with open ceilings may be installed exposed on wall near bottom of structure and above manual control location.
 - 3. Rooms with inaccessible (e.g. gypsum) ceilings: Install zone controller in adjacent room with accessible ceiling or adjacent back-of-house room with open ceiling. Mark location of zone controller on as-built drawing.
- B. Manual Controls
 - 1. Install low voltage wall stations at locations shown on plans. All cabling shall be per manufacturer's recommendation. Connect to zone controller.
 - 2. Program each button function per Digital Lighting Control System – Switch Schedule on plans.
 - 3. Install custom button labels for $\$_{LV}$ wall stations and suitable cover plates for all manual controls.
- C. Digital Occupancy Sensors
 - 1. Connect to zone controller per manufacturer's recommendation.
 - 2. It shall be the contractor's responsibility to locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Rooms shall have 90% - 100% coverage (minor motion in office environments).
 - 3. Ceiling sensors shall not be installed within four (4) feet of HVAC air diffusers or heating blowers.
 - 4. Provide a minimum 6' service loop in the cable at the ceiling sensor location to allow for sensor relocation if necessary.

D. Digital Photo Sensors

1. Install the photo sensor at the location recommended by the manufacturer and connect to the system per manufacturer's recommendations utilizing any necessary interface.
2. Daylight harvesting shall begin only after the target foot-candle level(s) in the room has been reached. Light levels for initiating daylight harvesting of each zone shall be field programmed by the factory authorized representative during the start-up process.
3. Aim exterior photo cell north.

E. Network components

1. Install network segment manager(s) on a wall in MDF or IDF closet. Connect to dedicated, spare 20 amp, 1-pole circuit breaker in nearest 208/120 volt branch panel. Provide one (1) building network data drop to each segment manager meeting requirements of Specification 271500 Communications Horizontal Cabling. Coordinate internet access/IP address with owner's IT staff.

F. Accessories

1. Analog occupancy sensor interface: Install device above accessible ceiling in rooms with analog occupancy sensors. Quantity of interfaces needed determined by selected manufacturer based on lighting control requirements for the room.
2. Emergency lighting control devices: Override all dimming of life safety luminaires shown on plan that are part of the digital lighting control system upon normal power loss using UL924 listed device. Provide devices in quantities as needed.

3.2 WIRING INSTALLATION

- A. Install all low voltage cabling in raceways except where installed above accessible ceilings.
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions. Provide a physical barrier between

3.3 PRE-INSTALLATION MEETING

- A. A factory-authorized technician from the selected system manufacturer shall meet with the electrical contractor on-site prior to installation of the system to step through the installation process, important installation requirements and answer contractor questions.

3.4 SYSTEM START-UP

- A. Upon completion of the installation by the contractor, the installation of the devices shall be reviewed on-site by the manufacturer's factory authorized technician. This visit may be combined with the occupancy sensor startup and training visit. The owner shall be included in determining the initial programming of time sweeps and similar functions.
- B. The Electrical Contractor shall provide both the manufacturer and the Electrical Engineer with 10 working days written notice of the scheduled start-up date.

- C. Factory-authorized technician shall utilize the wireless configuration tool to program each digital lighting control system device per plans and owner input.
- D. Factory-authorized technician shall setup the web-based software provided with the digital lighting control system to fit the project and then program each system device per plans and owner input.

3.5 OWNER TRAINING

- A. After system start-up, the factory-authorized technician shall train the owner's representatives in the system architecture, components, programming and any necessary maintenance for the system. This training may take place during the system start-up trip. Operations and maintenance manuals shall be delivered to the owner prior to the owner training being scheduled.

END OF SECTION

SECTION 26 2416 – PANELBOARDS

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the main, distribution and branch circuit panelboards indicated by the Contract Documents with supplementary items necessary for proper installation.

1.2 REFERENCES

- A. Applicable provisions of Division 1 govern work under this Section.

1.3 SUBMITTALS

- A. Include outline and support point dimensions, voltage, main bus ampacity, and integrated short circuit ampere rating.
- B. Circuit breaker enumeration (frame, ATE, poles, I.C.): Indicate if circuit breakers are suitable for the panelboards' Fully Rated Equipment Rating, or where acceptable, are series connected devices that have been test verified and listed with UL (include documentation proving the compatibility of the proposed circuit breaker combinations). Circuit breakers do not have to be listed as series connected devices when all of the circuit breaker interrupting ratings are equal to, or greater than, the short circuit rating of the panelboard.
- C. When indicated on the panelboard schedule, a coordinated selective scheme between the main circuit breaker and branch/feeder circuit breakers so that under fault conditions the branch/feeder circuit breaker clears the fault while the main circuit breaker remains closed.
- D. Accessories.

1.4 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver panelboards in factory-fabricated water-resistant wrapping..
- B. Handle panelboards carefully to avoid damage to material components, enclosure and finish.
- C. Store in a clean, dry space and protected from the weather.

1.6 EXTRA MATERIALS

- A. Keys: Furnish two (2) keys for each panelboard to Owner.

PART 2 - PRODUCTS

2.1 MAIN AND DISTRIBUTION PANELBOARDS

- A. Panelboards: Circuit breaker type.
- B. UL label "SUITABLE FOR USE AS SERVICE EQUIPMENT" where used as service equipment.
- C. Enclosure: NEMA Type 1. Minimum cabinet size: 5-3/4 inches deep; 20 inches wide, with 5" minimum gutter space top and bottom. Constructed of galvanized code gauge steel.
- D. Provide cabinet front with hinged door with flush lock. Front cover shall be hinged to allow access to wiring gutters without removal of panel trim. Hinged trim shall be held in place with screw fasteners. Finish in manufacturer's standard gray enamel.
- E. Provide metal directory holders with clear plastic covers.
- F. Provide panelboards with copper bus (phase buses, bus fingers, etc.), ratings as scheduled on Drawings. Provide ground bars in all panelboards. Neutral and ground bars can be dual rated ALCU9. All spaces shall have bus fully extended and drilled for the future installation of breakers.
- G. Circuit breakers shall be 125 VDC/240 AC rated for nominal 208Y/120V panels and 480Y/277V rated for nominal 480Y/277V panels. Minimum interrupting ratings shall be 10,000 amperes for 120/208V circuits and 14,000 amperes for 277/480V circuits, unless higher rating noted on the Contract Documents.
- H. Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits. Breakers 225 ampere through 400 ampere shall have continuously adjustable magnetic pick-ups of approximately five to ten times trip rating.
- I. Electronic Trip Circuit Breakers: Where indicated on the Drawings, provide circuit breakers with electronic trip unit. Adjustable settings may include long-time, short-time, instantaneous, and ground fault pick-up and delay.
- J. Circuit breakers shall be bolt-on type with common trip handle for all poles. No handle ties of any sort will be approved.
- K. Shunt trip breakers shall be provided where indicated.
- L. Ground fault breakers shall be provided where indicated.

2.2 BRANCH CIRCUIT PANELBOARDS

- A. Lighting and Appliance Branch Circuit Panelboards: Circuit breaker type.
- B. UL label "SUITABLE FOR USE AS SERVICE EQUIPMENT" where used as service equipment.
- C. Enclosure: Type 1. Minimum cabinet size: 5-3/4 inches deep; 20 inches wide with 5" minimum gutter space top and bottom. Constructed of galvanized code gauge steel. Panel enclosure (back box) shall be of non-stamped type (without KO's) to avoid concentric break out problem.

- D. Provide surface cabinet fronts with concealed trim clamps, concealed hinge and flush cylinder lock all keyed alike. Front cover shall be hinged to allow access to wiring gutters without removal of panel trim. Hinged trim shall be held in place with screw fasteners. Finish in manufacturer's standard gray enamel.
- E. Provide flush cabinet fronts with concealed trim clamps, concealed hinge and flush cylinder lock all keyed alike. Finish in manufacturer's standard gray enamel.
- F. Provide metal directory holders with clear plastic covers.
- G. Provide panelboards with copper bus (phase buses, bus fingers, etc.), ratings as scheduled on Drawings. Provide ground bars in all panelboards. Neutral and ground bars can be dual rated ALCU9. All spaces shall have bus fully extended and drilled for the future installation of breakers.
- H. Minimum System (i.e. individual component) Short Circuit Rating: As shown on the Drawings.
- I. Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers. Provide UL Class A ground fault interrupter circuit breakers where shown on Drawings. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits. Breakers 225 ampere through 400 ampere shall have continuously adjustable magnetic pick-ups of approximately five to ten times trip rating.
- J. Do not use tandem circuit breakers.
- K. Circuit breakers shall be bolt-on type with common trip handle for all poles. No handle ties of any sort will be approved.
- L. Shunt trip breakers shall be provided where indicated.
- M. Ground fault breakers shall be provided where indicated.
- N. All of the panelboards provided under this section shall be by the same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. See specification section 260529 Hangers and Supports.
- B. Install panelboards plumb with wall finishes.
- C. Height: 6 ft to top.
- D. Install a crimp type stud termination to stranded conductor when terminating on circuit breakers without a captive assembly rated for terminating stranded conductors.
- E. Provide filler plates for unused spaces in panelboards.
- F. See specification section 260553 Identification. Provide typed circuit directory for each branch circuit panelboard. Circuit labels shall indicate actual loads served. Use final room numbers and names of equipment. Do not use panel directories used for construction purposes. Revise directory to reflect circuiting changes required to balance phase loads.

- G. Provide ARC flash identification per NFPA 70E.
- H. Stub five (5) empty 1" conduits to accessible location above ceiling or below floor out of each recessed panelboard. Cap these conduits to prevent material from entering them.
- I. Keep panel interior clean at all times.
- J. Cabinet exteriors shall be maintained free of mud, spray-on insulation, paint spray and all substances not placed on the exterior surface by the panelboard manufacturer.
- K. For panelboards located in areas accessible to the public, paint the exposed surfaces of the trims, doors, and boxes with finishes to match surrounding surfaces after the panelboards have been installed.
- L. Panel cabinets shall not be used as raceways or pull boxes for adjacent equipment. Panel cabinets shall not contain wire splices. Panel wiring shall be installed in a neat and workmanlike manner with wire conforming to the contours of the cabinet. Wire bundles shall be wire tied and installed in a manner to protect wire insulation from cover screws and other sharp edges. All phase conductors shall be labeled with a circuit number, readily visible to the panelboard front without removing the dead front cover. All neutral conductors shall be labeled with the circuit number, which they are associated with, within three inches of their termination point
- M. For circuit breakers being added to existing panelboards, coordinate the breaker type with existing panelboards. Modify the panel directory.
- N. Where new panels are to be installed in existing backboxes, backboxes shall have rust and scale removed from inside. Paint inside of backboxes with rust preventive paint before the new panel interior is installed. Provide new trim and doors for these panels. Covers shall fit tight to the box with no gaps between the cover and the box.

3.2 FIELD QUALITY CONTROL

- A. The Contractor shall circuit the panelboards as shown on the drawings. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 10 percent, rearrange circuits in the panelboard to balance the phase loads within 10 percent.
- B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections.

END OF SECTION

SECTION 26 2702 – EQUIPMENT WIRING

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the electrical connections indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Equipment included in this Section may be specified under other Divisions and/or Sections, or furnished by Owner, including, but not limited to:
 - 1. HVAC motors, VFDs, and panels
 - 2. Plumbing motors, VFDs, and panels
 - 3. Kitchen Equipment

1.2 REFERENCES

- A. Applicable provisions of Division 1 govern work under this Section.
- B. Section 260533 Raceway and Boxes for Electrical Systems.
- C. Section 260519 Low-Voltage Electrical Power Conductors and Cables.

1.3 COORDINATION

- A. Coordinate all equipment requirements with the various contractors and the Owner. Review the complete set of drawings and specifications to determine the extent of wiring, starters, devices, etc., required.

PART 2 - PRODUCTS

2.1 CORDS AND CAPS

- A. Straight-blade Attachment Plug: NEMA WD 1.
- B. Locking-blade Attachment Plug: NEMA WD 5.
- C. Attachment Plug Configuration: Match receptacle configuration at outlet provided for equipment.
- D. Cord Construction: Oil-resistant thermoset insulated multiconductor flexible cord with identified equipment grounding conductor, suitable for hard usage in damp locations.
- E. Cord Size: Suitable for connected load of equipment and rating of branch circuit overcurrent protection.

2.2 OTHER PRODUCTS

- A. Refer to related sections for other product requirements.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 PREPARATION

- A. Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of connections. Coordinate details of equipment connections with supplier and installer.

3.3 INSTALLATION

- A. Use wire and cable with insulation suitable for temperatures encountered in heat-producing equipment.
- B. Make conduit connections to equipment using flexible PVC-coated metal conduit.
- C. Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.
- D. Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes.
- E. Make wiring connections in control panel or in wiring compartment of pre-wired equipment in accordance with manufacturer's instructions. Provide interconnecting wiring where indicated.
- F. Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature switches as indicated. Connect with conduit and wiring as indicated.
- G. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

3.4 HVAC AND PLUMBING CONNECTIONS

- A. Provide all power wiring including all circuitry carrying electrical energy from panelboard or other source through starters, variable frequency drives (VFDs), and disconnects to motors or to packaged control panels. Packaged control panels may include disconnects and starters and overcurrent protection. Provide all wiring between packaged control panels and motors.
- B. VFD Installations: Install VFD input wiring and output wiring in separate conduit systems. Do not mix VFD input power and output power, or control wiring in a common raceway.
- C. Provide 120 volts to each temperature control panel. Coordinate requirements with HVAC/DDC contractors.

- D. Unless otherwise specified, all electrical motors and control devices such as aquastats, float and pressure switches, fan powered VAV boxes, switches, electro-pneumatic switches, solenoid valves and damper motors requiring mechanical connections shall be furnished and installed and wired by the Contractor supplying the devices.
- E. Each motor terminal box shall be connected with a minimum 12", maximum 36" piece of flexible PVC-coated metal conduit to a fixed junction box. Conduit must be installed perpendicular to direction of equipment vibration to allow conduit to freely flex.
- F. Check for proper rotation of each motor.

3.5 KITCHEN EQUIPMENT CONNECTIONS

- A. Check loose equipment delivered to job by equipment installer against approved shop drawings or other required Drawings. Loose electrical equipment including disconnects, starters, thermostats, controls, local and remote switches shall be furnished by equipment contractor and installed by electrical contractor.
- B. Equipment contractor will receive all equipment and position in place.
- C. Equipment contractor shall provide dimensioned equipment layouts, detailed shop drawings of equipment showing locations and method of installing loose equipment and making final connections, and wiring and control diagrams.
- D. Electrical Contractor shall rough in for kitchen equipment only from approved kitchen equipment shop drawings.
- E. Rough in location shall be within three inches of equipment. If direct connection is required, use liquidtight flexible conduit. If receptacle connection is required, verify proper receptacle configuration with equipment installer.
- F. Final connections shall include extension of all service to each piece of equipment. All labor and material required to completely connect the equipment ready to operate shall be included in the final connections. All control wiring not integral with equipment shall be included.
- G. Equipment contractor shall provide services of their representatives and or equipment manufacturer's representative at appropriate stage of construction to answer the Contractor's questions concerning the final connections.
- H. For kitchen exhaust hoods provide all required power and control wiring. This may include (but is not limited to) the following:
 - 1. Provide switch in hood and branch circuit for integral light fixtures.
 - 2. Provide pushbutton switch or manual starter for exhaust fan.
 - 3. Provide emergency branch circuit for fire suppression system. Wire automatic heat detectors or manual station so, when activated, valve of dry chemical bottle opens, gas solenoid valve shuts down, all dampers close, and make-up fans shut down, electrical power contactor opens (integral in equipment), and building fire alarm system is activated. Provide all required wiring conduit and final connections. Refer to wiring diagrams supplied with equipment.

4. Wire washdown system; refer to schematic wiring diagrams supplied with hoods. Interconnect fire prevention system with washdown system so washdown system is activated upon alarm.

3.6 EQUIPMENT CONNECTION SCHEDULE

- A. As indicated on the drawings.

END OF SECTION

SECTION 26 2713 - ELECTRICITY METERING

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the utility metering requirements as well as metering/monitoring equipment for the Owner's use indicated by the Contract Documents with supplementary items necessary for proper installation.

1.2 REFERENCES

- A. Applicable provisions of Division 1 govern work under this Section.

1.3 SUBMITTALS

- A. Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Describe electrical characteristics, features, and operating sequences, both automatic and manual.
- B. Dimensioned plans and sections or elevation layouts (if applicable).
- C. Submit Utility Company prepared drawings (if applicable).

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Receive, store, and handle modular meter center according to NECA 400.

1.6 COORDINATION

- A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:
 - 1. Comply with requirements of utilities providing electrical power services.
 - 2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

- A. The following will be furnished by utility company:

1. Meter
 2. Primary service including conduits where required.
 3. Pad-mounted utility transformer
 4. Primary and secondary terminations at the utility transformer.
- B. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.
- C. Meter Sockets: Comply with requirements of electrical-power utility company.
- D. Meter Sockets: Steady-state and short-circuit current ratings shall meet indicated circuit ratings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with equipment installation requirements in NECA 1.
- B. Contact Utility Company and make arrangements to obtain permanent electric service to the Project.
- C. Utility transformer pad shall be furnished and installed by the General Contractor to utility company's specifications.
- D. Install meters furnished by utility company. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for primary cabling, metering leads and extend grounding connections as required by utility company.
- E. Install modular meter center according to NECA 400 switchboard installation requirements.

3.2 IDENTIFICATION

- A. Comply with requirements for identification specified in specification section 260553 Identification for Electrical Systems.
1. Series Combination Warning Label: Self-adhesive type, with text as required by NFPA 70.
 2. Equipment Identification Labels: Adhesive film labels with clear protective overlay.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections

1. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
2. Turn off circuits supplied by metered feeder and secure them in off condition.
3. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
4. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.

C. Electricity metering will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

SECTION 26 2726 – WIRING DEVICES

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the following wiring devices indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Equipment included in this Section
 - 1. Wall switches
 - 2. Receptacles
 - 3. Wall dimmers
 - 4. Device plates and box covers
 - 5. Access floor boxes
 - 6. Photo cells

1.2 REFERENCES

- A. Applicable provisions of Division 1 govern work under this Section.

1.3 SUBMITTALS

- A. Provide product data showing model numbers, configurations, finishes, dimensions, and manufacturer's instructions.

1.4 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state, and local requirements, and shall conform to codes and ordinances of authorities having jurisdiction.
- B. Provide factory fabricated wiring devices in the type and electrical rating for the service indicated. Where type and grade are not indicated provide proper selection to correspond with branch circuit wiring and overcurrent protection.

- C. Attachment of wires to devices shall be by screw pressure under the head of binding screws. Arrangements depending on spring pressure or tension are not acceptable. All binding screws shall be brass or bronze.
- D. See Drawings for Device Schedule.

2.2 DEVICE COLOR

- A. Ivory, unless noted otherwise.

2.3 WALL SWITCHES

- A. Wall Switches for Lighting Circuits and Motor Loads Under 1/2 HP: Quiet-type single pole through four (4)-way.
- B. Heavy duty use toggle switch, nylon or high impact resistant face and body, rated 20 amperes and 120/277 volts AC.
- C. Switches shall be UL20 Listed and meet Federal Specification WS-896. All switches shall be heavy duty Specification Grade with separate green ground screw.
- D. All switches shall be back and side wired, screw clamp type, suitable for solid or stranded wire up to #10 AWG.

2.4 STRAIGHT-BLADE RECEPTACLES

- A. Nylon or high impact resistant face, NEMA configuration as scheduled on the Drawings.
- B. Receptacles shall be UL498 Listed and meet Federal Specification WC-596.
- C. All receptacles shall be back and side wired, screw clamp type, suitable for solid or stranded wire up to #10 AWG, with a separate green ground screw. Connector-type receptacles are also acceptable.
- D. Hospital grade receptacles shall be tested and listed according to applicable standards and shall be readily identified on the face of the device by a green dot.

2.5 TWIST LOCK RECEPTACLES

- A. Nylon or high impact resistant face, NEMA configuration as scheduled on the Drawings.
- B. Receptacles shall be UL498 Listed and meet Federal Specification WC-596.
- C. All receptacles shall be back and side wired, screw clamp type, suitable for solid or stranded wire up to #10 AWG, with a separate green ground screw.

2.6 GROUND FAULT CIRCUIT INTERRUPTER (GFCI) RECEPTACLES

- A. Duplex convenience receptacle, Specification Grade, with integral ground fault current interrupter, auto monitoring (self-test), and line-load reversal function meeting the requirements of UL standard 943 Class A and UL standard 498.

- B. Hospital grade GFCI receptacles shall be tested and listed according to applicable standards and shall be readily identified on the face of the device by a green dot.
- C. All receptacles installed in outdoor locations, in garages, within six (6) feet of the outside edge of sinks, and in other damp or wet locations shall be GFCI type.

2.7 TAMPER RESISTANT RECEPTACLES

- A. Tamper resistant receptacles shall be similar to standard receptacles except for the addition of a shutter system that blocks access to the phase and neutral plug slots while the device is not in use.

2.8 SPECIFIC USE RECEPTACLE

- A. Configuration: As indicated on drawings.

2.9 WALL DIMMERS

- A. Wall Dimmers: Linear slide type or electronic to match the load served. Loads may include the following:
 - 1. LED lighting
- B. Rating: 600 Watts minimum, larger size to accommodate load shown on Contract Drawings.

2.10 DEVICE PLATES AND BOX COVERS

- A. Cover Plate
 - 1. Finished Spaces: Smooth thermoplastic nylon. Note requirement for red plates on emergency outlets.
 - 2. Unfinished Spaces: Smooth thermoplastic nylon. Note requirement for red plates on emergency outlets.
 - 3. Mechanical and Electrical Rooms: Smooth thermoplastic nylon. Note requirement for red plates on emergency outlets.
- B. Weatherproof Cover Plate: Gasketed plastic with hinged cover, wet location listed while in use.

2.11 PHOTO CELLS

- A. The controller shall be rated 2000 watts tungsten at 120, 240 or 277 volts. The cell shall be cadmium sulfide, 1" diameter.
- B. The enclosure shall be die cast zinc, gasketed for maximum weather proofing.
- C. The enclosure shall include the positioning lug on the top of the enclosure.
- D. The unit shall have a delay of up to two (2) minutes to prevent false switching. ON/Off adjustment shall be done by moving a light selector with a range from two (2) to fifty (50) foot-candles.

- E. Mounting shall be for a 1/2" conduit nipple.
- F. The unit shall have a five (5) year warranty.
- G. The contacts shall be SPST normally closed.
- H. The operational temperature range shall be -40 to 140° F.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All dimensions noted are centerline dimensions.
- B. Install wall switches 42 inches above floor, OFF position down.
- C. Install wall dimmers 42 inches above floor; de-rate ganged dimmers as instructed by manufacturer; do not use common neutral.
- D. Install convenience receptacles 18 inches above floor, 6 inches above counters or backsplash, grounding pole on bottom. Mount horizontally where indicated.
- E. Install boxes for information outlets 18 inches above finished floor. Install boxes for telephone jack for wall telephones 54 above finished floor.
- F. Install specific-use receptacles at heights shown on Contract Drawings.
- G. Poke-through device installation: Unit shall permit all wiring to be completed at floor level. Use is defined by the UL Fire Resistance Directory as a minimum spacing of "two (2) ft. (610 mm) on center and not more than one (1) device per each 65 sq. ft. (6 m²) of floor area in each span." Installation shall be completed by pushing unit down into the cored hole. Prior to and during installation, refer to system layout and/or approval drawings. Installer shall comply with detailed manufacturer's instruction sheet included with each device. The unit shall contain a retainer for securing the device in the slab, as well as the necessary intumescent material to seal the cored hole under fire conditions.
- H. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- I. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.
- J. Install devices and wall plates flush and level.
- K. Receptacles shall have a bonding conductor from grounding terminal to the metal conduit system. Self-grounding receptacles using mounting screws as bonding means are not approved.

3.2 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Operate each wall switch with circuit energized and verify proper operation.

- C. Verify that each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.

3.3 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Mark all conductors with the panel and circuit number serving the device with a machine generated label, at the device, and on the back of the device cover.

END OF SECTION

SECTION 26 2728 – DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install disconnect switches, fuses and enclosures indicated by the Contract Documents with supplementary items necessary for proper installation.

1.2 REFERENCES

- A. Applicable provisions of Division 1 govern work under this Section.

1.3 SUBMITTALS

- A. Include outline drawings with dimensions, and equipment ratings for voltage, ampacity, horsepower, and short circuit.

1.4 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

PART 2 - PRODUCTS

2.1 DISCONNECT SWITCHES

- A. Fusible Switch Assemblies (use only when overcurrent protection is required): NEMA Type Heavy Duty; quick-make, quick-break, load interrupter, enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: designed to accommodate Class R cartridge type fuses.
- B. Nonfusible Switch Assemblies: NEMA Type Heavy Duty; quick-make, quick-break, load interrupter, enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
- C. Provide auxiliary contacts on fusible switches serving elevator controllers.
- D. Solid neutral bus when neutral conductor is included with circuit.
- E. Provide manufacturer's equipment ground kit in all disconnect switches.
- F. Enclosure: NEMA Type as indicated on Drawings.
- G. Current rating and number of poles as indicated on drawings.

2.2 FUSES

- A. Fuses 600 Amperes and Less: Dual element, time delay, 600 volt, UL Class Interrupting Rating: 200,000 rms amperes.
- B. Fuses 601 Amperes and Larger: Time delay, 600 volt, UL Class L. Interrupting Rating: 200,000 rms amperes.
- C. Provide three (3) spares of each size and type fuse. Provide enclosure for spare fuse.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install disconnect switches where indicated on Drawings.
- B. Install switches so that the maximum height above the floor to the center of the operating handle does not exceed 6'-6".
- C. Provide conduit and wiring from the auxiliary contacts on the elevator disconnect switch to the elevator controller. Coordinate installation with the elevator vendor.
- D. Provide identification as specified in Section 260553.

END OF SECTION

SECTION 26 2813 – FUSES

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install 250 and 600 volt fuses indicated by the Contract Documents with supplementary items necessary for proper installation.

1.2 REFERENCES

- A. Applicable provisions of Division 1 govern work under this Section.

1.3 EXTRA MATERIALS

- A. Provide three (3) spares of each size and type used on the Project in a keyed lockable fuse cabinet (keyed to Owner's master electrical key).
- B. Fuse cabinet to be mounted in main switchgear room of the building as designated by Owner.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.2 FUSES RATED 600 VOLTS OR LESS

- A. Fuses for Safety Switches (Motor Circuits) and Service Disconnects:
 - 1. Cartridge Type (250 Volts, 600 Amperes or Less): Dual element time-delay, UL Class RK-5, 200,000 amperes R.M.S. symmetrical interrupting capacity.
 - a. Cooper Industries Inc.'s/Bussman Div. Type FRN-R
 - b. Mersen Type TR-R
 - c. Littlefuse Inc.'s Type FLN-R
 - 2. Cartridge Type (600 Volts, 600 Amperes or Less): Dual element time-delay, UL Class RK-5, 200,000 amperes R.M.S. symmetrical interrupting capacity.
 - a. Cooper Industries Inc.'s/Bussmann Div. Type FRS-R
 - b. Mersen Type TRS-R
 - c. Littlefuse Inc.'s Type FLS-R
 - 3. Cartridge Type (600 Volts or Less - Above 600 Amperes): Current limiting, UL Class L, 200,000 amperes R.M.S. symmetrical interrupting capacity.
 - a. Cooper Industries Inc.'s/Bussmann Div. Type KTU
 - b. Mersen Type A4BY
 - c. Littlefuse Inc.'s Type KLP-C

B. Fuses for Safety Switches (Lighting and Heating Circuits):

1. Cartridge Type (250 Volts): Single element, UL Class RK-1, 200,000 amperes R.M.S. symmetrical interrupting capacity.
 - a. Cooper Industries Inc.'s/Bussmann Div., Type KTN-R
 - b. Mersen Type A2K-R
 - c. Littlefuse Inc.'s Type KLN-R
2. Cartridge Type (600 Volts): Single element, UL Class RK-1, 200,000 amperes R.M.S. symmetrical interrupting capacity.
 - a. Cooper Industries Inc.'s/Bussmann Div. Type KTS-R
 - b. Mersen Type A6K-R
 - c. Littlefuse Inc.'s Type KLS-R

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fuses shall not be installed until equipment is ready to be energized.
- B. Install fuse with label oriented such that manufacturer, type, and size are easily read.
- C. Install spare fuse storage enclosure in Electrical Room or where indicated on the Drawings.

END OF SECTION

SECTION 26 4313 - SURGE PROTECTION DEVICES (SPDs)

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install surge protection devices (SPD) as indicated by the Contract Documents with supplementary items necessary for proper installation.

1.2 REFERENCES

- A. SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable UL standard (ANSI/UL 1449 3rd Edition).
- B. IEEE C62.41 Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

1.3 SUBMITTALS

- A. The following information shall be submitted to the Engineer:
 - 1. Product data and manufacturer's installation instructions.
- B. Provide verification that the SPD complies with the required ANSI/UL 1449 3rd Edition listing by Underwriters Laboratories (UL) or other Nationally Recognized Testing Laboratory (NRTL). Compliance may be in the form of a file number that can be verified on UL's website or on any other NRTL's website, as long as the website contains the following information at a minimum:
 - 1. Model number.
 - 2. SPD Type.
 - 3. System voltage, phases.
 - 4. Modes of protection.
 - 5. Voltage Protection Rating (VPR).
 - 6. Nominal Discharge Current (In).
- C. For sidemount mounting applications (SPD mounted external to electrical assembly), electrical/mechanical drawings showing unit dimensions, weights, installation instruction details, and wiring configuration.

1.4 QUALITY ASSURANCE

- A. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years.

- B. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.
- C. The specified system shall be thoroughly factory tested before shipment. Testing of each system shall include but shall not be limited to quality control checks, dielectric voltage withstand tests at twice rated voltage plus 1000 volts per UL requirements, and operational and calibration tests.

1.5 SUMMARY

- A. The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into electrical distribution equipment such as switchgear, switchboards, panelboards, busway (integrated within bus plug), or motor control centers.

1.6 RELATED WORK

- A. Applicable provisions of Division 1 govern work under this Section.
- B. Section 262416 – Panelboards

1.7 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions.

1.8 OPERATION AND MAINTENANCE MANUALS

- A. Operation and maintenance manuals shall be provided with each SPD shipped.

1.9 WARRANTY

- A. The manufacturer shall provide a full five (5) year warranty from date of shipment against any part failure when installed in compliance with manufacturer's written instructions, UL listing requirements, and any applicable national or local electrical codes. Manufacturer shall make available field engineering service support.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Square D
- B. Siemens
- C. General Electric
- D. Eaton Cutler-Hammer

- E. Mersen
- F. Erico/Critec
- G. Liebert
- H. Current Technology

2.2 VOLTAGE SURGE SUPPRESSION – GENERAL

A. Electrical Requirements

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 125% of the nominal system operating voltage.
3. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

Configuration	Protection Modes			
	L-N	L-G	L-L	N-G
Wye	•	•	•	•
Delta	N/A	•	•	N/A
Single Split Phase	•	•	•	•
High Leg Delta	•	•	•	•

4. Nominal Discharge Current (I_n) – All SPDs applied to the distribution system shall have a 20kA I_n rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an I_n less than 20kA shall be rejected.
5. ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 3rd Edition VPR for the device shall not exceed the following:

Modes	208Y/120	480Y/277
L-N; L-G; N-G	700	1200
L-L	1200	2000

B. SPD Design

1. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life.
2. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV.

3. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method.
5. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:
 - a. Protection Status Indicators - Each unit shall have an indicator light that reports the status of the protection on each phase.
 - 1) For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional indicator light that reports the status of the protection elements and circuitry in the N-G mode.
 - 2) For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.
 - b. Remote Status Monitor – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.
 - c. Audible Alarm and Silence Button – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.
6. Overcurrent Protection
 - a. The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.
7. Fully Integrated Component Design – All of the SPD's components and diagnostics shall be contained within one discrete assembly.
8. Safety Requirements
 - a. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.
 - b. Sidemount SPDs shall be factory sealed in order to prevent access to the inside of the unit. Sidemount SPDs shall have factory installed phase, neutral, ground and remote status contact conductors factory installed and shall have a pigtail of conductors protruding outside of the enclosure for field installation.

2.3 SYSTEM APPLICATION

- A. The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.
- B. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category
--

Category	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	250 kA	125 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards, MCCs, Busway)	120 kA	60 kA

- C. SPD Type – all SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

2.4 LIGHTING AND DISTRIBUTION PANEL REQUIREMENTS

- A. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.
1. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
 2. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
 3. The panelboard shall be capable of re-energizing upon removal of the SPD.
 4. The SPD shall be interfaced to the panelboard via a direct bus bar connection. Alternately, an SPD connected to a 30A circuit breaker for disconnecting purposes may be installed using short lengths of conductors as long as the conductors originate integrally to the SPD. The SPD shall be located directly adjacent to the 30A circuit breaker.
- B. Sidemount Mounting Applications Installation (SPD mounted external to electrical assembly):
1. Lead length between the breaker and suppressor shall be kept as short as possible to ensure optimum performance. Any excess conductor length shall be trimmed in order to minimize let-through voltage. The installer shall comply with the manufacturer's recommended installation and wiring practices.

2.5 SWITCHGEAR, SWITCHBOARD, MCC AND BUSWAY REQUIREMENTS

- A. The SPD application covered under this section is for switchgear, switchboard, MCC, and busway locations. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.
1. The SPD shall be of the same manufacturer as the switchgear, switchboard, MCC, and busway.

2. The SPD shall be factory installed inside the switchgear, switchboard, MCC, and/or bus plug at the assembly point by the original equipment manufacturer.
 3. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
- B. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
1. The SPD shall be integral to switchgear, switchboard, MCC, and/or bus plug as a factory standardized design.
 2. All monitoring and diagnostic features shall be visible from the front of the equipment.

2.6 ENCLOSURES

- A. All enclosed equipment shall have NEMA 1 general purpose enclosures, unless otherwise noted. Provide enclosures suitable for locations as indicated on the drawings and as described below:
1. NEMA 1 – Constructed of a polymer (units integrated within electrical assemblies) or steel (sidemount units only), intended for indoor use to provide a degree of protection to personal access to hazardous parts and provide a degree of protection against the ingress of solid foreign objects (falling dirt).

PART 3 - EXECUTION

3.1 FACTORY TESTING

- A. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

3.2 INSTALLATION

- A. The Contractor shall install all equipment per the manufacturer's recommendations and the contract drawings.

END OF SECTION

SECTION 26 5113 – INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the equipment indicated in the Contract Documents with supplementary items necessary for a proper and functioning installation.
- B. Section Includes:
 - 1. Interior luminaires
 - 2. Exit signs

1.2 REFERENCES

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to this Section.
- B. Refer to Division 26 Section “Low Voltage Electrical Power Conductors and Cables” for wiring requirements

1.3 SUBMITTALS

- A. Product data:
 - 1. For each luminaire type, submit a technical cut sheet with complete model number(s) and included options clearly noted, plus luminaire support points, weight, accessory information and photometric performance data indicating total luminaire efficiency. Place luminaire type (e.g. ‘F1’) at the top of each cut sheet page for that luminaire.
 - 2. Submit a technical cut sheet for the associated driver proposed for that luminaire. When multiple luminaires use the same driver, a single cut sheet for the driver may be submitted with all luminaires utilizing that driver clearly labeled on the cut sheet.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit under requirements and format listed in Division 26 Section “Common Work Results”.
- B. Include the following documentation
 - 1. All required submittals for this section, updated to reflect required changes from review comments.
 - 2. Warranty letter(s) indicating dates of coverage and warranty claim contact information.

1.5 QUALITY ASSURANCE

- A. Electrical components and accessories: Listed and labeled as defined in NFPA 70, Article 100,

by a testing agency acceptable to authorities having jurisdiction and marked for intended use.

- B. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

1.6 DEFINITIONS

- A. CRI: Color rendering index
- B. CCT: Correlated color temperature
- C. BUG: Backlight, Uplight and Glare ratings for luminaires based on IESNA TM-15-07.

1.7 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported from structure, including HVAC equipment, fire-suppression system, and partition assemblies.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver luminaires in factory-fabricated packaging.
- B. Handle lighting fixtures carefully to prevent breakage, denting and scoring the fixture finish. Do not install damaged lighting fixtures.
- C. Store product in a clean, dry space protected from weather.

1.9 WARRANTY

- A. All equipment shall be warranted to be free of defects in materials and workmanship by the manufacturer for the time period listed below from the date of project substantial completion:
 - 1. LED luminaires (including LED power supply): Five (5) years

1.10 EXTRA MATERIAL

- A. Special Tools - Two (2) tools to remove and install each type and size of fasteners on fixtures equipped with vandal resistant fasteners.

PART 2 - PRODUCTS

2.1 INTERIOR LUMINAIRES

- A. Refer to the Luminaire Schedule on the drawings for types of luminaires (e.g. F1, F2, EM1, etc.). The luminaire type listed in the schedule will appear on the lighting plans adjacent to the symbol for each luminaire.
- B. For each luminaire type the manufacturer and model listed first in the schedule, in conjunction with all other luminaire attributes listed on the schedule, shall be considered the basis of design. The remaining acceptable manufacturers shall meet or exceed the performance of the basis of

design. When a discrepancy exists between the model number and the other attributes listed for that luminaire, the Contractor shall ask for clarification during the bidding process or include the more expensive option as part of their bid.

- C. Provided luminaire doors with rubber, fiberglass gaskets or equivalent material to prevent light leak. Luminaires shall be provided with proper thermal protection as required for surrounding environment.
- D. Acrylic lenses shall be prismatic and not less than 0.125-inches thick nominal, unless noted otherwise on plans.
- E. All luminaire finishes shall be factory applied unless specifically noted otherwise. Refer to schedule on drawings for finish color.

2.2 SOLID STATE LUMINAIRES

- A. Photometric Measurement: Comply with IESNA LM-80-21.
- B. Lumen Maintenance: Tested in accordance to IESNA LM-79-19.
- C. Long Term Lumen Maintenance: Comply with IESNA TM-21-11.
- D. The basis of design for each LED luminaire is listed on the Luminaire Schedule. All other listed acceptable manufacturers shall meet or exceed the delivered lumens of the basis of design using +/- 10% input watts.
- E. CRI and CCT per Luminaire Schedule on plans

2.3 EXIT SIGNS

- A. Mounting type and chevrons shall be as indicated on the Drawings. Lettering and chevron-type directional indicators shall comply with NFPA 101, Life Safety Code, and shall be Listed in accordance with UL 924, Standard for Safety Emergency Lighting and Power Equipment.
- B. Sign housing type shall be as indicated on the Luminaire Schedule.
- C. Mounting canopies will be of identical construction and color to match the exit frame.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install luminaires at locations and heights as indicated, in accordance with luminaire manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation", NEMA Standards and with recognized industry practices to ensure that luminaires fulfill requirements.
- B. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

- C. Check the building electrical system requirements and architectural finishes. Regardless of the catalog number prefixes and suffixes shown, furnish fixtures with the proper trim, frames, supports, hangers, driver, voltage rating, and other miscellaneous appurtenances to properly coordinate with Project conditions. Verify with Engineer prior to ordering.
- D. Check the type of ceilings to be installed in each room and verify that the recessed light fixtures are proper for the type of ceiling to be installed before ordering fixtures. Provide a frame compatible with the type of ceiling in which the recessed lighting fixture is installed. Refer to the Architectural Room Finish Schedule for the specified ceiling type.
- E. Install suspended luminaires and exit signs using pendants supported from swivel hangers. Heavy duty jack chain supports may be used where indicated on the fixture schedule. Provide pendant or chain length required to suspend luminaire at indicated height.
- F. Support luminaires larger than 2 x 4 foot size independent of ceiling framing using #12 steel wires anchored to structure.
- G. Locate ceiling luminaires as indicated on the architectural reflected ceiling plan.
- H. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.
- I. Finishing Collar or Combination Finishing Collar/Outlet Box (Surface Mounted Fixture Used With Exposed Raceway):
 - 1. Provide finishing collar where surface mounted fixture is installed on an exposed raceway outlet box and the fixture base is larger than the outlet box.
 - 2. Provide combination finishing collar/outlet box where surface mounted fixture is not indicated to be installed on an exposed raceway outlet box, but raceway cannot be run directly into fixture body due to fixture design.
- J. The Contractor shall install fixture supports as required. Fixture installations with fixtures supported only by insecure boxes will be rejected. It shall be the Contractor's responsibility to support all lighting fixtures adequately, providing extra steel work for the support of fixtures if required. Any components necessary for mounting fixtures shall be provided by the Contractor. No plastic, composition or wood type anchors shall be used.
- K. Install recessed luminaires to permit removal from below.
- L. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- M. Install wall mounted luminaires at height as scheduled.
- N. Install accessories furnished with each luminaire.
- O. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- P. Bond fixtures and metal accessories to branch circuit equipment grounding conductor.
- Q. Protect installed fixtures from damage during the remainder of the construction period.

3.2 ADJUSTING AND CLEANING

- A. Align luminaires and clean lenses and diffusers at completion of Work. Clean paint splatters, dirt, and debris from installed luminaires.
- B. Aim and adjust luminaires as indicated on Drawings or as directed by the Architect/Engineer.
- C. Touch up luminaire finish at completion of work.

3.3 FIXTURE CONNECTIONS

- A. Direct box or conduit connections for surface and recessed fixtures. Flexible metal conduit from a J-box for recessed lay-in light fixtures. Flexible metal conduit shall be minimum 3/8" diameter and six foot maximum length. Conduit length shall allow movement of the fixture for maintenance purposes.
- B. The flexible connectors shall be all steel, galvanized, clamp type with locknut or snap-in connector including those used on the master-slave unit.
- C. Fixture whips shall be supported to prevent them from lying on or being supported by the ceiling grid. Supports shall be listed for raceway support. Tape and other temporary means are not acceptable.

3.4 FIELD QUALITY CONTROL

- A. Upon completion of installation of interior lighting fixtures, and after circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at the Project Site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.
- B. All existing fixtures in work area that are re-used or relocated shall be cleaned inside and out, broken or damaged parts replaced and new lamps installed.

END OF SECTION

SECTION 26 5200 – EMERGENCY LIGHTING-UNIT EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the following emergency lighting-unit equipment indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Equipment included in this Section
 - 1. Emergency lighting units
 - 2. Exit signs

1.2 REFERENCES

- A. Applicable provisions of Division 1 govern work under this Section.

1.3 SUBMITTALS

- A. Include outline drawings, lamp and ballast data, battery/charger information, support points, weights, accessory information and performance data for each luminaire type.
- B. For each luminaire type, submit luminaire information in the following example table format, and submit catalog cuts with highlighted catalog numbers and required accessories.

LUMINAIRE		BALLAST	LAMP	ANSI INPUT WATTS
Type	Manufacturer and Catalog No.	Manufacturer, Quantity per Fixture, and Catalog No.	Manufacturer, Quantity per Fixture, and Catalog No.	

1.4 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver lighting fixtures individually wrapped in factory-fabricated fiberboard type containers.
- B. Handle lighting fixtures carefully to prevent breakage, denting and scoring the fixture finish. Do not install damaged lighting fixtures.
- C. Store product in a clean, dry space protected from weather.

PART 2 - PRODUCTS

2.1 EXIT/EMERGENCY LIGHTING AND ACCESSORIES

- A. See the Luminaire Schedule on the drawings, for type of fixtures and catalog numbers. Catalog numbers are shown on the drawings for quality and performance requirements only. Fixtures manufactured by others are equally acceptable provided they meet or exceed the performance of the indicated fixtures, and meet the intent of the design.
- B. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.2 REMOTE LIGHTING HEADS

- A. Acceptable Manufacturers: As indicated on the Drawings.
- B. Remote head mounting shall be as indicated on the Drawings.
- C. Housing material shall be as indicated on the Drawings.
- D. Lamp type, quantity, voltage, and wattage shall be as indicated on the Drawings.
- E. Units shall comply with NFPA 101, Life Safety Code, and shall be Listed in accordance with UL 924, Standard for Safety Emergency Lighting and Power Equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- C. Check the building electrical system requirements and architectural finishes. Regardless of the catalog number prefixes and suffixes shown, furnish fixtures with the proper trim, frames, supports, hangers, ballasts, voltage rating, and other miscellaneous appurtenances to properly coordinate with Project conditions. Verify with Engineer prior to ordering.
- D. Check the type of ceilings to be installed in each room and verify that the recessed light fixtures are proper for the type of ceiling to be installed before ordering fixtures. Provide a frame compatible with the type of ceiling in which the recessed lighting fixture is installed. Refer to the Architectural Room Finish Schedule for the specified ceiling type.
- E. Install suspended luminaires using pendants supported from swivel hangers. Chain or cable supports may be used in unfinished spaces or where indicated on the fixture schedule. Provide pendant, chain, or cable length required to suspend luminaire at indicated height.
- F. Fixture whips shall be supported to prevent them from lying on or being supported by the ceiling grid. Supports shall be listed for raceway support. Tape and other temporary means are not acceptable.

- G. Locate exit and emergency luminaires as indicated on the Drawings. Install accessories furnished with each luminaire.
- H. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prohibit movement.
- I. Finishing Collar or Combination Finishing Collar/Outlet Box (Surface Mounted Fixture Used With Exposed Raceway):
 - 1. Provide finishing collar where surface mounted fixture is installed on an exposed raceway outlet box and the fixture base is larger than the outlet box.
 - 2. Provide combination finishing collar/outlet box where surface mounted fixture is not indicated to be installed on an exposed raceway outlet box, but raceway cannot be run directly into fixture body due to fixture design.
- J. The Contractor shall install fixture supports as required. Fixture installations with fixtures supported only by insecure boxes will be rejected. It shall be the Contractor's responsibility to support all lighting fixtures adequately, providing extra steel work for the support of fixtures if required. Any components necessary for mounting fixtures shall be provided by the Contractor. No plastic, composition or wood type anchors shall be used.
- K. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- L. Bond fixtures and metal accessories to branch circuit equipment grounding conductor.
- M. Protect installed fixtures from damage during the remainder of the construction period.
- N. Insert a copy of the battery warranty in each unit and mark on batteries the date placed in service.
- O. Emergency Lighting Units
 - 1. Units shall be mounted so that they may easily be removed for service.
 - 2. Units shall be permanently connected to a 120/277 volt power source in compliance with the NEC.
 - 3. Remote lamps shall be connected to battery unit using raceway and wire size noted on the Drawings.
- P. Emergency Ballasts and Generator Transfer Device
 - 1. Install in accordance with manufacturer's instructions.
 - 2. Where provided, install remote test/monitoring plate and location indicated on the Drawings.

3.2 ADJUSTING AND CLEANING

- A. Align luminaires and clean lenses and diffusers at completion of Work. Clean paint splatters, dirt, and debris from installed luminaires.
- B. Aim and adjust luminaires as indicated on Drawings or as directed by the Architect/Engineer.

- C. Touch up luminaire finish at completion of work.

3.3 FIELD QUALITY CONTROL

- A. Upon completion of installation of interior lighting fixtures, and after circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at the Project Site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

END OF SECTION

SECTION 26 5629 – SITE LIGHTING

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install site lighting indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. Equipment included in this Section
 - 1. Exterior luminaires and accessories
 - 2. Poles
 - 3. Foundations

1.2 REFERENCES

- A. Applicable provisions of Division 1 govern work under this Section.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate dimensions and components for each luminaire, pole and base.
- B. Product Data: Provide dimensions, ratings, performance data, lamp and ballast data, weights and accessory information for each type.
- C. Manufacturer's Instructions:
 - 1. Indicate application conditions and limitations of use stipulated by product testing agency specified under "Regulatory Requirements".
 - 2. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- D. Light Layout: Provide a computer generated factory point to point foot-candle layout of the project for each area involved.
- E. Design Data: Include lighting calculations.

1.4 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of each luminaire, pole and underground circuit.
- B. Provide record drawings of the final, as installed and measured, point to point foot-candle layout for each area involved.

1.5 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.6 COORDINATION

- A. Use bolt templates and pole mounting accessories to install anchor bolts in pole base.

1.7 WARRANTY

- A. All equipment shall be warranted to be free of defects in materials and workmanship by the manufacturer for the time period listed below from the date of project substantial completion:
 - 1. LED luminaires (including LED power supply): Five (5) years
 - 2. Pole (including pole finish): Five (5) years

PART 2 - PRODUCTS

2.1 LUMINAIRES

- A. Furnish products as specified in schedule on Drawings.

2.2 FUSES

- A. Furnish and install a fuse holder and fuse in each ungrounded leg of the electrical circuit supplying the outdoor luminaire. Every luminaire shall be separately fused with a waterproof fuse holder. Size the fuse for the amperage of the luminaire. Tap the circuit conductors with a minimum #10 AWG conductor to serve the luminaire. The fuse and holder shall be accessible through the handhole. Provide sufficient wire to bring fuse holder outside of handhole.

2.3 POLES

- A. Furnish products as specified in schedule on Drawings.
- B. Handhole: With removable weatherproof cover.
- C. Anchor Bolts: As recommended by pole manufacturer. Provide template, flat washers, lock washers, and hex nuts for each pole.

2.4 POLE FOUNDATIONS

- A. Construct from reinforced concrete in sizes as shown on drawings and to meet the minimum structural requirements of the site soil conditions.
- B. Provide 3/4" X 10'0" ground rod in the pole foundation so that the ground rod projects 3" up into center of pole base.
- C. The exposed surface area of the foundation shall have the forms removed and the concrete rubbed out to a smooth finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturers' instructions.
- B. Minimum underground conduit size is 1 inch.
- C. Underground and exterior wire shall be type XHHW-2.
- D. Project anchor bolts 2 inches minimum above base.
- E. Install all anchor bolts and handhole fasteners with anti-seize compound.
- F. Install poles plumb. Provide shims or double nuts to adjust plumb.
- G. Use belt slings or non-chafing ropes to raise and set pre-finished luminaire poles.
- H. Bond each luminaire, each metal accessory, the ground rod and the pole to the branch circuit equipment ground conductor with a separate ground wire sized per NEC or as shown on the drawings.

3.2 FIELD QUALITY CONTROL

- A. Operate each luminaire after installation and connection. Inspect for improper connections and operation.

3.3 ADJUSTING

- A. Aim and adjust luminaires as indicated on Drawings or as directed by the A/E.
- B. All new lamps shall be operational at the Substantial Completion of the project.

3.4 CLEANING

- A. Clean photometric control surfaces.
- B. Clean finishes and touch up damage.

END OF SECTION

DIV 27 –BASIC COMMUNICATIONS SYSTEMS TABLE OF CONTENTS

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SECTION 27 0513 – COMMUNICATIONS COMMON WORK RESULTS

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the required remote control and signal cabling indicated by the Contract Documents with supplementary items necessary for proper installation.

1.2 SUMMARY

- A. Section includes
 - 1. Contractor Responsibility and Qualifications
 - 2. Reference Standards and Codes
 - 3. Required Contractor Training
 - 4. Quality Assurance
 - 5. Permits, Fees, and Certificates of Approval
 - 6. Submittals
 - 7. Product Assurance
 - 8. Coordination
 - 9. Alternates, Substitution and Change Orders
 - 10. Project Management
 - 11. Delivery and Storage
 - 12. Cleaning
 - 13. Painting

1.3 CONTRACTOR RESPONSIBILITY AND QUALIFICATION

- A. The chosen Communications Contractor (here after referred to as Contractor) shall provide a minimum one (1) year warranty on material, installation and workmanship.
- B. Contractor shall provide all components, materials, services and labor essential for a complete and functional structured cabling system.
- C. The Contractor shall be responsible for complying with all local, state and federal laws and regulations applicable to the work performed, although said law, rule or regulation is not identified herein.

- D. Examination of building and site shall be the responsibility of the Contractor: Contractors shall examine site and building as required prior to installation to determine any conditions affecting the scope of work. Contact Owner representative for arrangements. All systems and cabling are assumed working and in good condition unless contractor documents exceptions.
- E. Contractor shall call for all inspections required. Final payment of this contract will not be made until final inspections have been completed and all deficient items noted have been corrected.
- F. Contractor will respect and protect the privacy and confidentiality of Owner, its employees, processes, products, and intellectual property to extent necessary, consistent with the legal responsibilities of the State of Iowa and Owner policies.
- G. Use of sub-contractors: The Contractor shall inform in writing to Owner's representative and General Contractor about the intention to use sub-contractors and the scope of work for which they are being hired. Owner's representative prior to the sub-contractor's hiring and start of any work must approve the use of sub-contractors in writing.
- H. Contractor will be required to provide a sufficient number of technicians for this project to stay on schedule.
- I. Contractor shall identify the qualifications of their technician. Vendor shall also identify the type(s) of certifications / testing that its technicians go through before and after being hired on by your company.
- J. Contractor must identify plan and as-built documentation processes used by your company, such as AutoCAD, Adobe and Bluebeam.
- K. Installers: Only technicians certified by equipment manufacturer are approved.

1.4 REFERENCE STANDARDS AND CODES

- A. Supervisors and lead installers shall have a working knowledge and understanding of the following documents and codes are their most recent updates, and shall be familiar with the requirements that pertain to this installation. Installers shall be familiar with and have practical working knowledge of the requirements that pertain to this installation.
- B. Codes: Comply with applicable sections of the most recent editions and addenda of following for interior and exterior installations. Ensure you are using the latest and most up to date standards regulations applicable. [NOTE: All installations within non-State owned properties shall comply with all applicable codes and regulations adopted by the authorities having jurisdiction.]
 - 1. International Building Code (IBC)
 - 2. National Electrical Code (NEC/NFPA 70)
 - 3. National Electrical Safety Code (NESC IEEE)
- C. Standards: Comply with applicable sections of the most recent editions and addenda of the following for installations and testing of communications cabling, connectors, and related hardware. Comply with applicable sections of the following for interior and exterior installations.
 - 1. IEEE Std 1100, Recommended Practice for Powering Grounding Sensitive Electronics

2. TIA/EIA-568-B1.1, Commercial Building Telecommunications Cabling Standard Part 1: General Requirements.
 3. TIA/EIA-568-B.2-4, Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components
 4. TIA/EIA-569-A-7, Commercial Building Standard for Telecommunications Pathways and Spaces.
 5. ANSI/TIA/EIA-569-A, Commercial Building Standards for Telecommunications Pathways and Spaces.
 6. TIA/EIA-606-A, Administration Standard for Commercial Telecommunications Infrastructure.
 7. J-STD-607, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
- D. BICSI: Comply with the most current editions of the following BICSI manuals:
1. BICSI – Telecommunications Distribution Methods Manual
 2. BICSI – Installation Transport Systems Information Manual
 3. BICSI – Network Design Reference Design Manual
 4. BICSI – Wireless Design Reference Manual
 5. BICSI – Electronic Safety and Security Design Reference Manual

1.5 ELECTRONIC DOCUMENT RELEASE

- A. Electronic versions of the bid documents will be made available to the contractors for use during the bidding process and to help generate fabrication drawings for various systems. A summary of the requirements for the various document types is listed below:
1. PDF
 - a. Contact the Construction Manager or Architect to obtain a PDF version of the Bid Documents. No Document Release Form is required.
 2. AutoCAD
 - a. Bluestone Engineering can provide an AutoCAD version of the bid documents for the contractor to use for generating shop drawings and fabrication drawings. This will include plan drawings with the architectural background. The contractor is responsible for incorporating any modifications that occur during bidding by all disciplines. Details and schedules will not be included.
 - b. A document release form (see attached) will be required to be completed by the contractor to determine the version of AutoCAD and drawings required. No fee is associated with these drawings.
 3. REVIT
 - a. The REVIT drawings will be converted to AutoCAD and then transferred to the contractor.

- b. Bluestone Engineering can provide an AutoCAD version of the bid documents for the contractor to use for generating shop drawings and fabrication drawings. This will include plan drawings with the architectural background. The contractor is responsible for incorporating any modifications that occur during bidding by all disciplines. Details and schedules will not be included.
- c. A document release form (see attached) will be required to be completed by the contractor to determine the version of AutoCad and drawings required.
- d. Submittal of the document release form will be required prior to the AutoCAD files being transmitted.

1.6 SUBSTITUTION

- A. All manufacturers listed as Acceptable Manufacturers in each specification section are considered equal to the basis of design. The basis of design is preferred and will take precedence. Any products from an alternate approved manufacturer need to meet the requirements and performance specified and shall be equal to the basis of design.
- B. The Contractor may request permission for a substitution of any item (equipment or material), subject to the following conditions:
 - 1. Submit substitution requests in writing to the Engineer, on a form supplied by the Engineer. A sample copy of this form is included at the end of this section. An electronic copy can also be provided to the Contractor by the Engineer.
 - 2. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contractor documents, the Contractor is responsible for all costs involved in integrating the equipment or accessories into the system and the assigned space and for obtaining the performance from the system into which these items are placed as well as any re-design costs incurred by the Architect or Engineer. The Contractor is also responsible for coordinating changes required by other trades.
 - 3. Any requests for alternate manufacturers must be submitted to the Architect/Engineer at least ten (10) days prior to bid day. Incomplete substitution requests will not be considered.
- C. Approval
 - 1. No work involving requests for substitution shall commence without written approval on the provided form by the Engineer.
 - 2. Any work started or material ordered/installed by the Contractor without written approval shall be removed/repared at the sole expense of the Contractor. The Contractor will also be responsible for any costs incurred by the Owner for such rework.

1.7 REQUIRED CONTRACTOR TRAINING

- A. The Contractor shall be fully conversant and capable in the cabling of low voltage applications such as, but not limited to data, voice and imaging network systems. The Contractor shall at a minimum possess the following qualifications:
 - 1. Personnel trained and certified to install the Structured Cabling System.

2. The Installer shall show proof of current "Certified Installer" of the Structured Cabling System via an updated certificate given after attending the appropriate training course or an on-line re-certification class.
3. Provide references for the type of installation provided in this specification.
4. Personnel trained in the installation of pathways and support for housing horizontal cabling.

1.8 QUALITY ASSURANCE

- A. Build America, Buy America: All equipment and infrastructure shall comply with the federal "Build America, Buy America Act" (BABAA) (Title IX of the Infrastructure Investment and Jobs Act of 2021 [Pub.L. 117-58, §§ 70901-70953] domestic preference requirements for iron and steel, manufactured products, and construction materials. Manufactured products shall be produced or manufactured in the U.S. and the percentage of costs of manufactured components mined, produced, or manufactured in the U.S. shall meet the current federal standard of 55%. Manufacturers that do not comply with BABAA will need approved waivers from the federal government on the basis of "domestic non-availability, unreasonable cost, or public interest" prior to the execution of contracts or purchase orders.
- B. Perform work in accordance with contract documents and governing codes and standards.
- C. All personnel performing the work of this Section shall be thoroughly familiar with the cabling methods set forth in the latest release of the BICSI TDMM (Building Industry Consulting Services International Telecommunications Distribution Methods Manuals).
- D. The installed cabling systems shall not generate nor be susceptible to any harmful electromagnetic emission, radiation, or induction that degrades cabling systems.
- E. Expansion Capability: Unless otherwise indicated, provide spare positions in wall fields, cross connects, and terminal strips, and space in cable pathways to accommodate twenty (20) percent future growth in campus distribution and riser.
- F. Backward Compatibility: The provided solution shall be backward compatible with lower category ratings such that if higher category components are used with lower category components, the permanent link and channel measures shall meet or exceed the lower channel's specified parameters.
- G. Component Compliance: The provided solution's components shall each meet the minimum transmission specifications listed herein such that no individual component will be less than specifications for permanent and channel, regardless of the fact that tests for permanent and channel ultimately meet required specifications.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.2 SUBMITTALS

- A. Manufacturer or contractor compliance letter for compliance with the “Build America, Buy America Act” (BABAA). Include the following:
 - 1. Company name
 - 2. Company addresss
 - 3. Project name
 - 4. Statement of compliance with the babaa requirements.
 - 5. List of items, projects, and/or materials specific to the project that the submitted letter includes.
 - 6. Location of manufacturing processes
 - 7. Authorized company or contractor signature
 - 8. Date
- B. General
 - 1. Bill of materials, noting any long lead time items in business days. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number as indicated in the Contract Documents.
 - 2. Proposed test forms for horizontal UTP cable.
 - 3. Project schedule including all major work components that materially affect any other work on the project.
 - 4. Basis of Design Certification of Structure Cabling System
 - 5. System Drawings: Project specific system drawing noting systems components and interconnection between components. The interconnection of components shall clearly indicate all wiring required in the system.
- C. Firestop design basis documentation that shall include each type of communication penetration, type of building construction being penetrated including the hourly resistance rating of floor, wall, or other partition of building construction into which firestop design will be installed, and firestop device or system proposed for use.
- D. Installation Procedures and Material Safety Data Sheets shall be included with products delivered to the job site.
- E. Informational Submittals
 - 1. Manufacturer’s Installation, Start-Up and Adjustment Instructions.
 - 2. Certificates:
 - a. Certify that field tests have been performed and that work meets or exceeds specified requirements.

- b. Certify that factory tests have been performed and that work meets or exceeds specified requirements. Certificates may be based on recent or previous test results, provided material or products tested are identical to those proposed for this Project.
 - c. Calibration report of test equipment for copper. Last calibration date should not be older than one (1) year from the 1st day of testing.
- 3. Field Test Results: Submit sample cable test results showing report format and parameter test.
- 4. Operation and Maintenance Data
- 5. Special Warranty: With respect to the installation of the Structure cabling system, furnish the Structured Cabling System applications extended warranty.

2.3 PRODUCT ASSURANCE

- A. All materials shall be UL and/or ETL approved and labeled in accordance with NEC for all products where labeling service normally applies.
- B. Materials and equipment requiring UL 94, 149, or 1863 listing shall be so labeled. A modification of products that nullifies UL labels is not permitted.
- C. All materials and equipment provided shall be the standard Commercial-Off-The-Shelf (COTS) products of a manufacturer engaged in the manufacture of such products. All materials shall be typical commercial designs that comply with the requirements specified. All materials and equipment shall be readily available through manufacturers and/or distributors. All equipment shall be supplied complete with any optional items required for proper installation.
- D. Materials or Manufacturers not listed in this Division 27 but are required materials to provide a complete and functioning cable infrastructure system shall have cut sheets and product data included in the material and procedures submittal package.
- E. Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance and backward compatibility.
- F. Contractor shall test all fiber cable while on the reel prior to installation of the cable. The Contractor shall assume liability for replacement of cable should it be found defective at this time or a later date prior to customer acceptance.

PART 3 - EXECUTION

3.1 COORDINATION

- A. Coordinate arrangement, mounting, and support of communications equipment with Architect or Owner.
 - 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 connecting pathways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- E. Contractor shall be responsible for coordination with all trades, to include required scheduling of materials and/or equipment with Owner and/or General Contractor for delivery, storage and protection of equipment as required.

3.2 FIELD QUALITY CONTROL

- A. The Contractor shall perform the following field inspections during installation and commissioning:
 1. Visually inspect cabling placements, pathways and terminations in communications equipment rooms, telecommunications rooms and work area's for compliance with standards and codes.
 2. Visually inspect grounding and bonding for compliance with standards and codes.
 3. Visually inspect all installed cable trays, cable pathways and wall penetrations for compliance with standards and codes.

3.3 ALTERNATES, SUBSTITUTIONS AND CHANGE ORDERS

- A. If a proposed alternate material is equal to or exceeds specified requirements, Contractor shall provide manufacturer's specifications in writing for written approval prior to purchase and installation of proposed materials. The proposed material substitution shall not void or change manufacturer's warranty.
- B. Contractor shall provide a complete cabling infrastructure according to these written specifications and drawings. If the Owner changes the scope of work to be performed by the Contractor, it shall be in writing. Contractor shall response to these changes with a complete material list, labor, and taxes in writing presented to the Owner for approval. Contractor shall not proceed with additional scope of work without a signed approval by the Owner.
- C. Additional work performed by the Contractor will not be paid by Owner without signed approval of these changes prior to implementing changes. Submit a copy of signed change order upon billing.

3.4 PROJECT MANAGEMENT

- A. Contractor shall designate a project manager to act as the single point of contact. Project manager shall oversee all work performed to ensure a quality installation compliant with specifications as outlined in documents (which includes all specifications and drawings). The

General Contractor to review a copy of resume of the on-site Project Manager and each on-site teams.

- B. The Contractor project manager/supervisor shall attend meetings arranged by Owner's representatives, and/or other parties affected by work of this Division 27.
- C. Contractor shall provide written progress reports to Owner's representative and other parties affected by work of this Division 27. This progress report must include:
 - 1. Update time schedule with estimate time of completion. This must be in MS Project format or equal to software, also showing the time baseline.
 - 2. Work performed last week.
 - 3. Work planned for the upcoming week.
 - 4. Percentage complete of work performed.
 - 5. Identify potential risks that can impact scope and/or the time schedule.

3.5 DELIVERY AND STORAGE

- A. The Contractor shall assume custody and responsibility for the items upon delivery and determining that the contents are complete and in satisfactory condition for installation.
- B. Delivery, loss, storage and protection: All materials and equipment delivered and placed in storage shall be stored with protection from the weather, humidity, and temperature variation, dirt, and dust, or other contaminants.
- C. Coordinate deliveries and submittals with the General Contractor/Owner to ensure a timely schedule installation.
- D. Contractor shall be responsible for all handling and control of cabling equipment. Contractor is liable for any material loss due to delivery and storage problems.
- E. Coordinate with General Contractor/Owner on location of storage materials.

3.6 AS-BUILTS

- A. Record copy and as-built drawings:
 - 1. The as built drawings shall include, but are not limited to block diagrams, frame and cable labeling, cable termination points, equipment room layouts, rack elevations and frame installation details. The as-builts shall include all field changes made up to construction completion:
 - a. Field directed changes to cross connect and patching schedule.
 - b. Horizontal cable routing changes.
 - c. Associated detail drawings.

3.7 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, dust, and construction debris and repair damaged finish, including chips, scratches, and abrasions. This includes touching up paint removed for grounding.
- B. Contractor shall provide a clean work environment, free from trash/rubbish accumulated during and after cabling installation.
- C. Maintain construction materials and refuse within the area of work. Clean the work area at the end of each day.
- D. Contractor shall keep all liquids (drinks, sodas, etc.) off finished floors, carpets, tiles racks and equipment. If any liquid damage to above finishes or equipment, Contractor shall provide professional services to clean or repair scratched/soiled finishes or damaged equipment at own expense.

3.8 PAINTING

- A. Touch up marred and bared surfaces of primed, galvanized, and finish painted equipment, materials, and accessories installed.
- B. Restore patched surfaces as close to the original condition and finish as reasonably possible. Where patching occurs in smooth painted surface, extend final paint coat over entire unbroken surface containing patch, after patched area has received two coats of primer and two coats of finished paint.

3.9 PROJECT CLOSEOUT REQUIREMENTS

- A. Final project closeout tasks
 - 1. Deliver all spare parts listed in each specification section. Deliver to Owner chosen location.
 - 2. All equipment labeled per specifications.
 - 3. All equipment cleaned and ready for use.
- B. Contractor Requirements
 - 1. Marked up drawings and specifications provided to Engineer for incorporation of as-built drawings or to serve as the as-built drawings depending on the project requirements. As-built drawings shall be clean and legible.
 - 2. Operation and Maintenance (O&M) Manuals shall include the following:
 - a. Contractor contact for warranty work.
 - b. Approved shop drawings, incorporating all review comments.
 - c. Warranty copies
 - d. Operation and maintenance instructions
 - e. Proposed test forms for fiber/copper backbone and horizontal UTP cables.

END OF SECTION

(ELECTRONIC DOCUMENT RELEASE & SUBSTITUTION REQUEST FORMS ATTACHED)

Document Release Form

Information Requested:

Project Name:
Drawings Requested:

Media Type: (Check all that are applicable)

- | | |
|---|--|
| <input type="checkbox"/> AutoCAD DWG Files (Version ____) | <input type="checkbox"/> Adobe PDF Files |
| <input type="checkbox"/> REVIT Files (Version ____) | <input type="checkbox"/> Other |

Requesting Party:

Name:	Address 1:
Company:	Address 2:
Signature:	Email Address:
Date:	Phone #:

KEDbluestone Use:

Form Sent By: _____ Date: _____

KEDbluestone Project #:

Data contained on these electronic files are part of our instruments of service and shall not be used by you or anyone else receiving these data through or from you for any purpose other than as a convenience in the preparation of shop drawings for the referenced project. Any other use or reuse by you or by others will be at your sole risk and without liability or legal exposure to us. You agree to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against us, our officers, directors, employees, agents or subconsultants that may arise out of or in connection with your use of the electronic files. Furthermore, you shall, to the fullest extent permitted by law, indemnify and hold us harmless against all damages, liabilities or costs, including reasonable attorneys' fees and defense costs, arising out of or resulting from your use of these electronic files. These electronic files are not construction documents. Differences may exist between these electronic files and corresponding hard-copy construction documents. We make no representation regarding the accuracy or completeness of the electronic files you receive. In the event that a conflict arises between the signed or sealed hard-copy construction documents prepared by us and the electronic files, the signed or sealed hard-copy construction documents shall govern. You are responsible for determining if any conflict exists. By your use of these electronic files, you are not relieved of your duty to fully comply with the contract documents, including, and without limitation, the need to check, confirm and coordinate all dimensions and details, take field measurements, verify field conditions and coordinate your work with that of other contractors for the project. Because information presented on the electronic files can be modified, unintentionally or otherwise, we reserve the right to remove all indicia of ownership and/or involvement from each electronic display.

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SUBSTITUTION REQUEST FORM (DURING BIDDING)

We submit for your consideration the following product instead of the specified item for the following project:

PROJECT: _____

SPEC. SECTION	SPEC. TITLE	PARAGRAPH	SPECIFIED ITEM
---------------	-------------	-----------	----------------

_____	_____	_____	_____
-------	-------	-------	-------

Proposed Substitution: _____

MANUFACTURER	TRADE NAME	MODEL NO.
--------------	------------	-----------

_____	_____	_____
-------	-------	-------

Attached data includes product description, specifications, drawings, photographs, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including Architectural and Engineering design, detailing, and construction costs caused by the substitution.

Submitted by:

Signature

Firm

_____ Telephone	_____ Email	_____ Date
--------------------	----------------	---------------

Engineer's Review and Action

☐ Substitution Approved

- ☐ Substitution Approved As Noted
- ☐ Substitution Rejected
- ☐ Substitution Request Received Too Late

Signed by:

_____ Date

Supporting Data Attached:

☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ Other _____

SUBSTITUTION REQUEST FORM (AFTER BIDDING)

We submit for your consideration the following product instead of the specified item for the following project:

PROJECT: _____

SPEC. SECTION

SPEC. TITLE

PARAGRAPH SPECIFIED ITEM

Proposed Substitution: _____

MANUFACTURER

TRADE NAME

MODEL NO.

INSTALLER

PHONE NO.

History: ☐ New Product ☐ 2-5 years old ☐ 5-10 years old ☐ More than 10 years old

Differences between proposed substitution and specified product: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ days

Savings to Owner for accepting substitution: \$ _____

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including Architectural and Engineering design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by:

Signature

Firm

Telephone

Email

Date

Engineer's Review and Action

- ☐ Substitution Approved
- ☐ Substitution Approved As Noted
- ☐ Substitution Rejected
- ☐ Substitution Request Received Too Late

Signed by:

Date

Supporting Data Attached:

- ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ Other _____

SECTION 27 0526 – GROUNDING/EARTHING AND BONDING

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the following Grounding/Earthing and Bonding for Communications Systems.
- B. This section includes minimum requirements for the following:
 - 1. Grounding/Earthing System
 - 2. Telecommunications Main Ground Busbar (TMGB)
 - 3. Rack Grounding/Earthing and Bonding
- C. All cables and related terminations, support and grounding/earthing hardware shall be furnished, installed, wired, tested, labeled, and documented by the telecommunications contractor as detailed in this document.
- D. Product specifications, general design considerations, and installation guidelines are provided in this document. Quantities grounding/earthing products, typical installation details and cable routing will be provided as an attachment to this document. If the bid documents are in conflict, this specification shall take precedence. The successful vendor shall meet or exceed all requirements for the cable system described in this document.

1.2 REFERENCES

- A. The following industry standards are the basis for the grounding/earthing and bonding system described in this document
 - 1. NFPA: NFPA-70 National Electric Code (NEC)
 - 2. IEEE: Std 1100 IEEE Recommend Practice for Powering and Grounding Electronic Equipment (IEEE Emerald Book)
 - 3. TIA/EIA:
 - a. TIA-942 Telecommunications Infrastructure Standard for Data Centers
 - b. J-STD-607-A Commercial Building Grounding/Bonding Requirements
 - c. TIA/EIA-606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
 - 4. International Standard: BS EN 50310:2000 Application of equipotential bonding and earthing in Buildings with information technology equipment.
- B. The most recent versions of all documents apply to this project. If there is a conflict between applicable documents, the order above shall dictate the order of precedence in resolving the issue unless an enforceable local or national code is in effect.

1.3 APPROVED PRODUCTS

- A. Approved grounding/earthing system manufacturer: Panduit
- B. Approved telecommunications grounding busbar manufacturer: Panduit
- C. Approved rack grounding kit manufacturer: Panduit

1.4 QUALITY ASSURANCE

- A. See the Panduit Electrical Product Warranty on [www. Panduit.com/warranty](http://www.Panduit.com/warranty)

1.5 DEFINITIONS

- A. Bonding – The permanent joining of metallic parts to form an electrically conductive path that will assure electrical continuity and the capacity to conduct safety any current likely to be imposed.
- B. Mesh Common Bonding Network (MCBN) – The mesh CBN (MCBN) can be readily utilized for efficient direct bonding of equipment and other apparatus to the grounding system. Such an arrangement provides efficient grounding and inter/intra-unit bonding of metal cabinets, racks and miscellaneous metal objects (especially when they are not powered). Additionally, the MCBN ensures grounding reliability of the equipment in the event the equipment grounding conductor of the serving power circuit is comprised or disconnected during maintenance. Electrostatic charge buildup and dissipation is also greatly aided by the multiple grounding paths of the CBN. See Figure 1.
- C. Ground/Earth (Earth)/Earthing is an international term equivalent to grounding) – A conducting connection, whether intentional or incidental, by which an electric circuit or equipment is connected to earth, or to some conducting body relatively large extent that serves in place of the earth.

1.6 OVERVIEW

- A. A primary purpose of the grounding/earthing and bonding system is to create an adequate capacity path for electrical surges and transient voltages to return to their source (which may include the earth).
- B. Lightning, fault currents, circuit switching (motors turning on and off), activation of surge protective devices (SPDs) and electrostatic discharge are common causes of these electrical surges and transient voltages. An effective grounding/earthing and bonding system minimizes the detrimental effects of these electrical surges and transient voltages, which include degraded network performance and reliability and increased safety risks.
- C. A properly constructed protection system includes a number of subsystems including:
 - 1. Grounding electrode system
 - 2. Lightning protection system
 - 3. Surge suppression
 - 4. AC/DC power systems grounding

5. Telecommunications supplemental grounding and bonding

- D. While each subsystem is designed with a specific intent in mind, the systems interact and enhance the overall capability of the entire protection system. This specification focuses primarily on the telecommunications supplemental grounding and bonding subsystem, hereafter referred to as the grounding, bonding, or grounding/earthing system.
- E. The grounding/earthing system must be intentional, visually verifiable, adequately sized to handle expected currents safely, and directs these potentially damaging currents away from sensitive network equipment. As such, grounding/earthing must be purposeful in its design and installation. Four issues require special consideration:
 - 1. Although AC powered equipment typically has a power cord that contains a ground/earth wire, the integrity of this path cannot be easily verified. Thus, many equipment manufacturers require grounding/earthing above and beyond that which is specified by local electrical codes, such as the National Electrical Code, etc. Always follow the grounding/earthing recommendations of the manufacturer when installing equipment.
 - 2. While the building steel and metallic water piping must be bonded to the grounding/earthing system for safety reasons, neither may be substituted for the telecommunications bonding backbone (TBB).
 - 3. Electrical continuity throughout each rack or cabinet is required to minimize safety risks. Hardware typically supplied with bolt-together racks is not designed for grounding/earthing purposes. Additionally, most racks and cabinets are deliberately bonded, continuity between members is incidental, and in many cases, unlikely.
 - 4. Any metallic component that is part of the data center, including equipment, racks, cabinets, ladder racks, enclosures, cable trays, etc., must be bonded to the grounding/earthing system.
- F. The ground/earth system must be designed for high reliability. Therefore, the grounding/earthing system shall meet the following criteria:
- G. Local electrical codes shall be adhered to.
- H. The grounding/earthing system shall comply with ANSI/TIA-942, J-STD-607-A, IEEE Std 1100™ (IEEE Emerald Book), and in international regions BS EN 50310:2000.
- I. All grounding/earthing conductors shall be copper.
- J. Lugs, HTAPs, grounding strips, and busbars shall be UL Listed and made of premium quality tin-plated electrolytic copper that provides low electrical resistance while inhibiting corrosion. Antioxidant shall be used when making bonding connections in the field.
- K. Wherever possible, two-hole lugs shall be used because they resist loosening when twisted (bumped) or exposed to vibration. All lugs shall be irreversible compression and meet NEBS Level 3 as tested by Telcordia. Lugs with inspection windows shall be used in all non-corrosive environments so that connections may be inspected for full conductor insertion (battery rooms are an exception where windowless lugs may be used).
- L. Die index numbers shall be embossed on all compression connections to allow crimp inspection.

- M. Cable assemblies shall be UL Listed and CSA Certified. Cable shall be a distinctive green or green/yellow in color, and all jackets shall be UL, VW-1 flame rated.

PART 2 - PRODUCTS

2.1 GROUNDING/EARTHING AND BONDING

- A. A telecommunications Main Grounding Busbar (TMGB) shall be located at the service entrance. A Telecommunications Grounding Busbar (TGB) shall be located in each telecommunications space. The TGB will be grounded/earthed to the Telecommunications Main Grounding Busbar (TMGB).
- B. The TMGB shall be bonded to building steel and grounded/earthed to the electrical service ground according to J-STD-607-A guidelines. Each TGB shall be bonded to building steel and the electrical panel serving equipment in the telecommunications space. See Figure 1 below.



Figure 1 – Service Entrance Grounding

The gauge of the connecting ground/earth cable, known as the Telecommunications Bonding Backbone (TBB) will follow J-STD-607-A guidelines, as is shown in the table below.

1. Sizing of the TBB	
TBB Length in Linear meters (feet)	TBB Size AWG
Less than 4 (13)	6 (16mm ²)
4-6 (14-20)	4 (25mm ²)
6-8 (21-26)	3 (25mm ²)
8-10 (27-33)	2 (35mm ²)
10-13 (34-41)	1 (35mm ²)
13-16 (42-52)	1/0 (50mm ²)
16-20 (53-66)	2/0 (70mm ²)
Greater than 20 (66)	3/0 (95mm ²)

- C. Route the TBB to each TGB in as straight a path as possible. The TBB should be installed as a continuous conductor, avoiding splices where possible. Use Panduit part number series HTWC to tap into the TBB where necessary. When more than one TBB is used, bond them together using the TGBs on the top floor and every third floor in between with a conductor known as a grounding equalizer (GE). Use the J-STD-607-A guidelines for sizing of the TBB when sizing the GE (shown in the table above).

2.2 COMPONENTS, KITS AND HARDWARE

- A. Panduit® StructuredGround™ Grounding System (StructuredEarth™ Earthing System) kits, components, and hardware shall be used to construct the grounding/earthing system.
- B. Use Panduit GB4 series BICSI/J-STD-607-A telecommunications grounding busbars for the TMGB, which is ideally located at the AC service entrance. Use a Panduit GB2 series busbar for the TGB in each of the other telecommunications/equipment spaces throughout the building. Use Panduit LCC-W series lugs when connecting conductors to the TMGB and TGB.

2.3 CONSTRUCTION OF THE GROUNDING/EARTHING SYSTEM

- A. Avoid routing grounding/earthing conductors in metal conduits. If the grounding/earthing conductor must be routed through a metal conduit, bond each end of the conduit to the grounding/earthing conductor. Use Panduit GPL series grounding clamps to bond to the conduit, a Panduit HTWC HTAP with clear cover to bond to the grounding/earthing conductor, and a #6 AWG copper conductor to connect the GPL grounding clamp to the HTWC HTAP.
- B. In telecommunications spaces with a small number of racks or cabinets, it may be most convenient to bond the grounding/earthing jumper cable directly to the TGB. Larger spaces require a mesh Common Bonding Network, as described below.

Cable Sizes for Other Grounding/Earthing Applications Not Specifically Described Elsewhere in This Document	
Purpose	Copper Code Cable Size
Aisle ground (overhead) of the common bonding network	Minimum #2 AWG (35mm ²)
Aisle ground (under floor) of the mesh common bonding network	Minimum # 6 AWG (16mm ²)
Bonding conductor to each PDU or panel board serving the room.	Size per NEC 250.122 & manufacturer recommendations
Bonding conductor to HVAC equipment	#6 AWG (16mm ²)
Building columns	#4 AWG (25mm ²)
2. Cable ladders and trays	#6 AWG (16mm ²)
Conduit, water pipe, duct	#6 AWG (16mm ²)

C. Wire Basket Bonding

1. Wire baskets shall be bonded per the manufacturer's installation instructions. Bond shall be made in accordance with Figure 2 above to the mesh Common Bonding Network.
2. Attached a #6 AWG (16mm²) jumper to the Wire Basket with a split bolt, Panduit part series SBCT. Then use a HTCT HTAP to attach the other end of the jumper to the mesh CBN.
3. Overhead Common Bonding Network and Ladder Rack Bonding
4. The overhead common bonding network shall be constructed of a minimum of a #2 AWG (35mm²) or larger gauge wire. The CBN shall be bonded to the TGB using a 2-hole copper compression connector, *PANDUIT* part series LCC-W or metric equivalent.
5. Ladder racks shall be bonded per the manufacturer's installation instructions. The bond shall be made in accordance with Figure 3 below to the mesh Common Bonding Network.

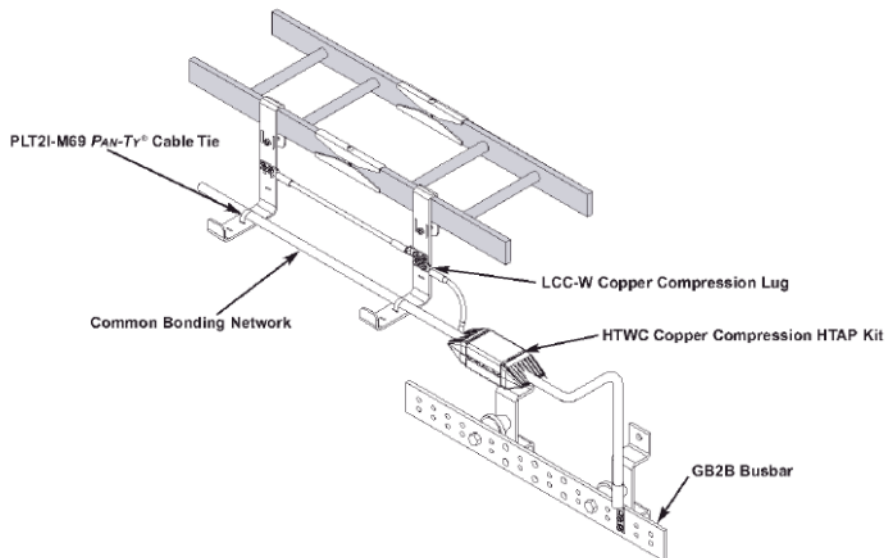


Figure 3 – Overhead Common Bonding Network and Ladder Rack Bonding

6. To provide electrical continuity between ladder rack segments use Panduit® StructuredGround™ Auxiliary Cable Bracket, Panduit part number GACB-1. When installed, the paint piercing teeth on the bracket remove paint from the ladder rack sections providing an electrical bond. There shall also be a grounding jumper, Panduit part number GACBJ618U, that connects to the auxiliary cable brackets to bond the sections of the ladder rack together.

2.4 RACK GROUNDING/EARTHING

- A. Equipment and racks shall be bonded in accordance with the methods prescribed in ANSI/TIA-942, as is shown in Figure 4 below.

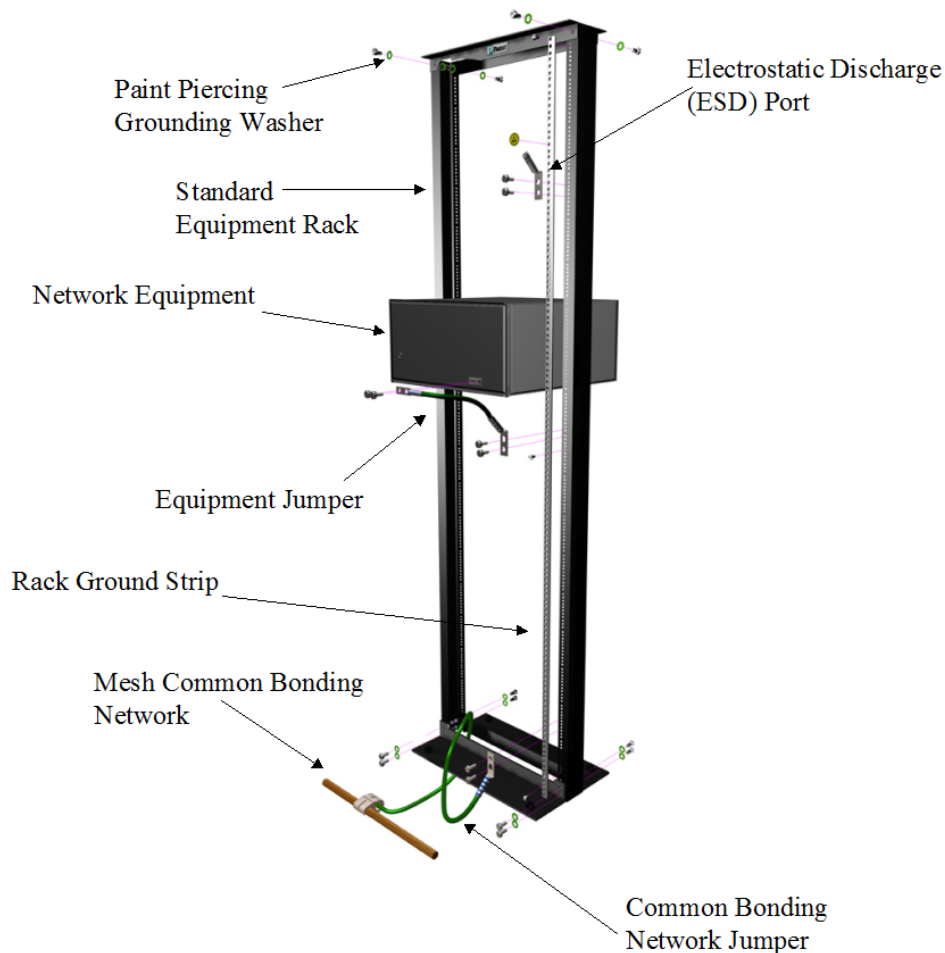


Figure 4 - Properly Grounded/Earthed Rack (Back of Rack Shown)

- B. To provide electrical continuity between rack elements, *PANDUIT* paint piercing grounding washers, series RGW, shall be used where rack sections bolt together, on both sides, under the head of the bolt and between the nut and rack.
- C. All racks shall utilize a full-length rack ground strip, *PANDUIT* series RGS, attached to the rear of the side rail with the thread-forming screws provided to ensure metal-to-metal contact.
- D. Mount an electrostatic discharge (ESD) port kit, *PANDUIT* series RGEDS, directly to the rack grounding strip on the back of the rack at approximately 48 inches (122cm) from the floor. Mount a second RGEDS directly to the vertical mounting rail of the rack in the front at approximately the same height. Use the thread-forming screws provided to form a bond to the rack. Place the ESD protection identification stickers directly above the ESD ports.
- E. When the equipment manufacturer provides a location for mounting a grounding connection, that connection shall be utilized. Use the appropriate *PANDUIT* RG series jumper for the equipment being installed and the thread-forming screws provided in the kit.
- F. Use *PANDUIT* part number series RGCBNJ (Common Bonding Network Jumper) to attach the rack ground strip to the mesh CBN. This kit includes the #6 AWG cable with one factory installed two-hole lug and hardware to connect to the busbar and one HTCT HTAP to connect

to the mesh CBN. In addition, all components can be utilized if your mesh common bonding network is below or overhead. Do not bond racks or cabinets serially. Use the HTCT HTAP that comes with the kit to bond the conductor directly to the mesh common bonding network.

- G. Patch panels will be bonded to racks using the appropriate PANDUIT bonding screws, series RGTBS. Mounting rails may utilize cage nuts, threaded holes or thru hole mounting fasteners to secure patch panels to the rails.

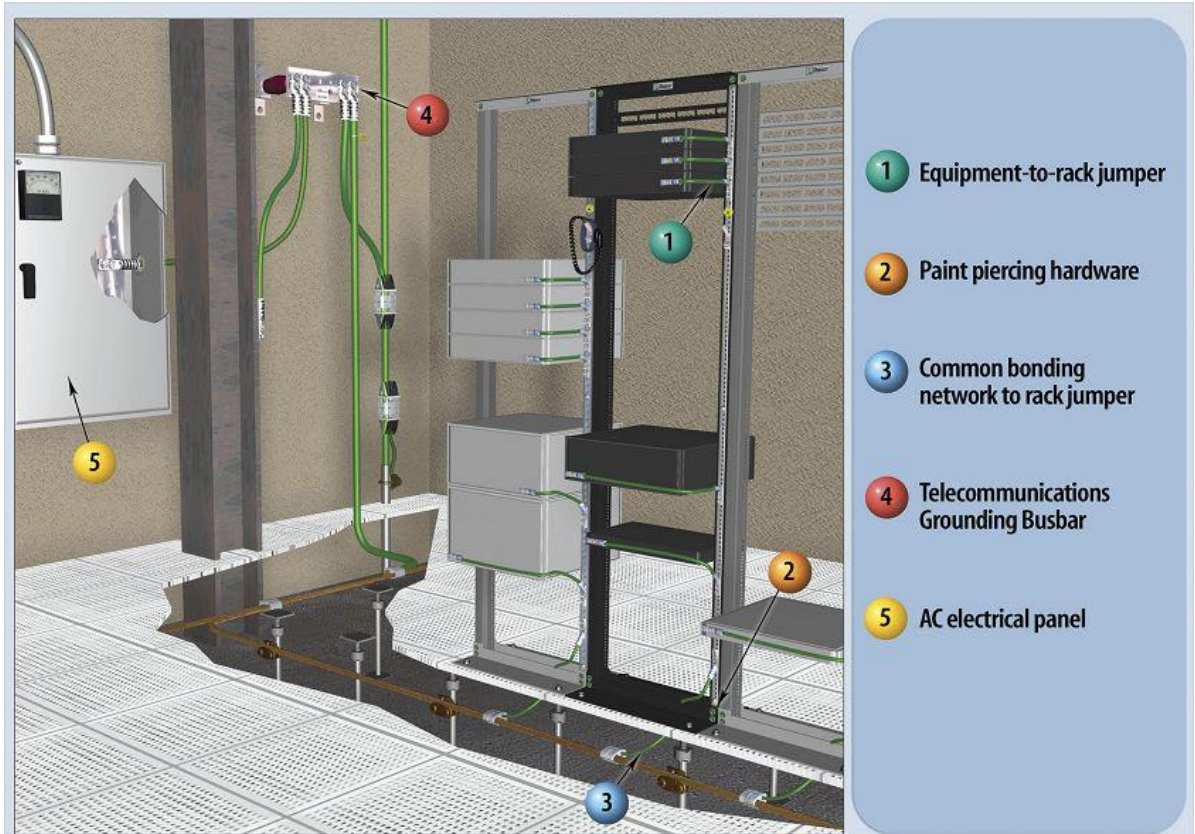
PART 3 - EXECUTION

3.1 GROUNDING SYSTEM

- A. The communications grounding system shall be designed and/or approved by a qualified PE, licensed in the state that the work is to be performed. The communications grounding system shall adhere to the recommendations of the ANSI/TIA-942 and J-STD-607-A standards, and shall be installed in accordance with best industry practice. International regions shall adhere to the recommendations of the BS EN 50310:2000 standard.
- B. A licensed electrical contractor shall perform installation and termination of the main bonding conductor to the building service entrance ground.

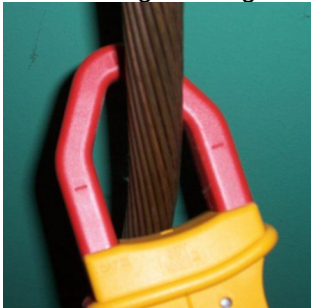
3.2 INSPECTION OF THE GROUNDING SYSTEM

- A. The following describes the process of properly inspecting information technology telecommunications supplemental grounding and bonding systems.
- B. An answer of "yes" for each question on the inspection list indicates that the components of the grounding and bonding system have been installed to commonly referenced industry standards.
- C. Use the room/rack/cabinet number space on each sheet to provide each measurement set with a unique identification number so that issues found during the inspection can be addressed later.

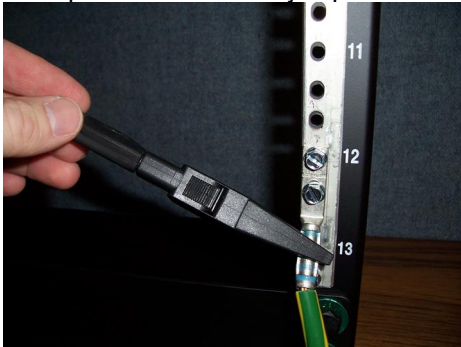
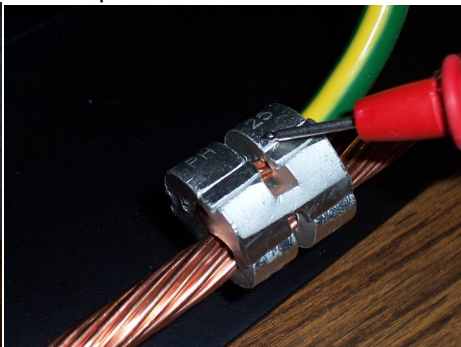


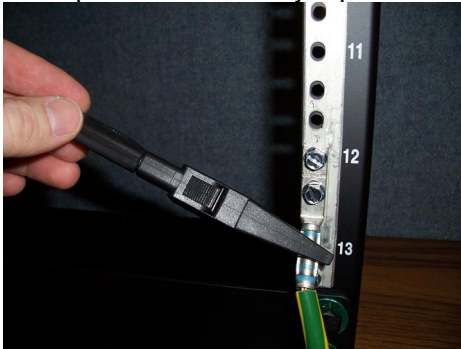

Is a Telecommunications Grounding Busbar (TGB) present?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Have the following bonds been made to the TGB?	
The AC electrical panel	<input type="checkbox"/> Yes <input type="checkbox"/> No
Accessible building steel	<input type="checkbox"/> Yes <input type="checkbox"/> No
The Mesh Common Bonding Network ¹	<input type="checkbox"/> Yes <input type="checkbox"/> No
The Telecommunications Bonding Backbone ²	<input type="checkbox"/> Yes <input type="checkbox"/> No

1. The Mesh Common Bonding Network (MCBN) is the conductor or group of conductors that extend from the TGB to each bay in the room. The MCBN can be installed above the bays or under the access floor.
2. The Telecommunications Bonding Backbone (TBB) is the conductor that bonds every TGB in the bonding network together. The TBB may not be present in every installation.

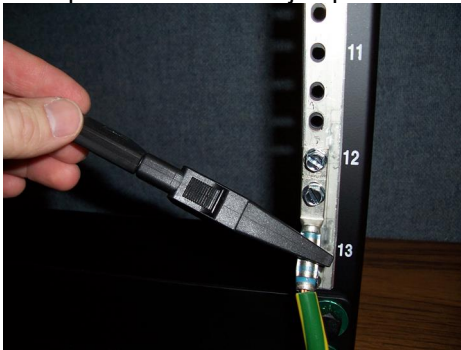
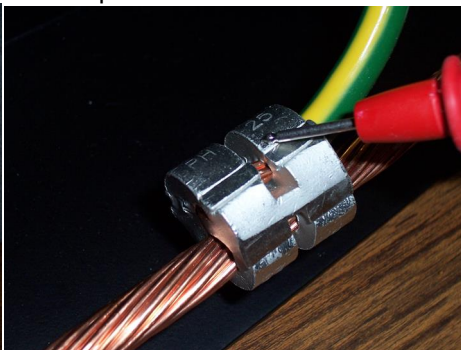
<p>Using a clamp-on amp meter, check for AC and DC current on each of the bonds listed above. A reading of zero amps AC and DC may be indicative of an open connection. A reading of greater than one amp may be indicative of fault conditions somewhere in the power system.</p> <p>Clamp the meter around the grounding conductor in question</p> 	<input type="checkbox"/> Yes <input type="checkbox"/> No
Are the AC and DC currents at acceptable levels?	
Are the bend radii of all these conductors greater than twelve inches?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Are all the bonds to the TGB made with two-hole compression lugs?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Is each conductor bonded to the TGB labeled or tagged "Do not disconnect"?	<input type="checkbox"/> Yes <input type="checkbox"/> No

D. Bonding inspections for each rack: Rack Number _____

Are electrostatic discharge (ESD) wrist strap ports available on the front and back of each rack?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Are two-hole compression lugs compression HTAPs used wherever possible?	<input type="checkbox"/> Yes <input type="checkbox"/> No
<p>Using a two-point resistance meter, measure the DC resistance between the common bonding network (CBN) to rack jumper and the HTAP connecting the jumper to the mesh common bonding network as shown below.</p> <div style="display: flex; justify-content: space-around;"> <div> <p>One probe on the CBN jumper:</p>  </div> <div> <p>One probe on the HTAP:</p>  </div> </div>	<input type="checkbox"/> Yes <input type="checkbox"/> No
Is the DC resistance $\leq 0.1\Omega$?	

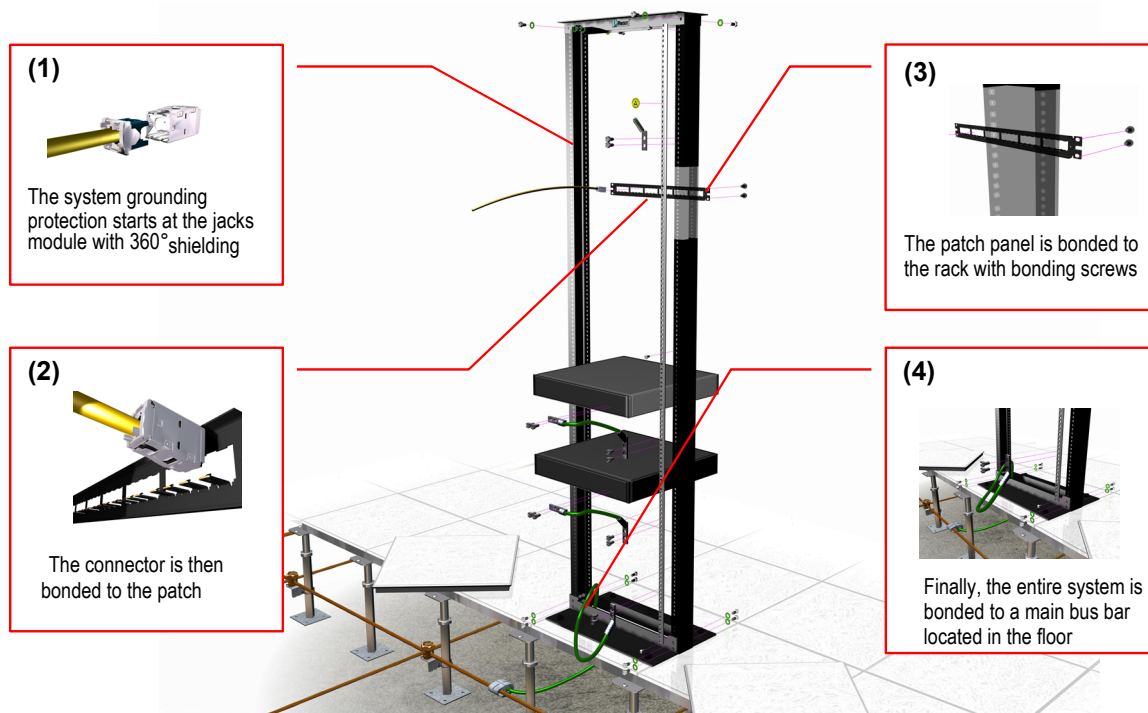
<p>Using a two-point resistance meter, measure the DC resistance between each section of the rack and the common bonding network to rack jumper as shown below.</p> <p>One probe on the CBN jumper: </p> <p>One probe on the washer: </p> <p>Is the DC resistance $\leq 0.1\Omega$ for each section of rack?</p>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<p>Using a two-point resistance meter, measure the DC resistance between the mounting flange of each piece of powered equipment and the common bonding network to rack jumper.</p> <p>Is the DC resistance $\leq 0.1\Omega$ for each piece of equipment?</p>	<input type="checkbox"/> Yes <input type="checkbox"/> No

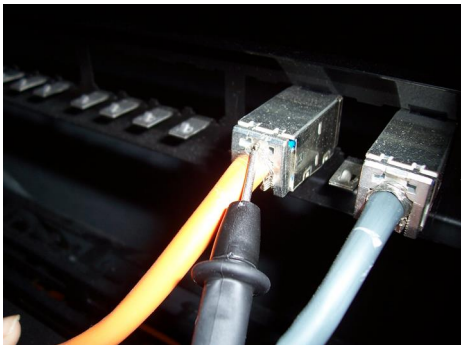
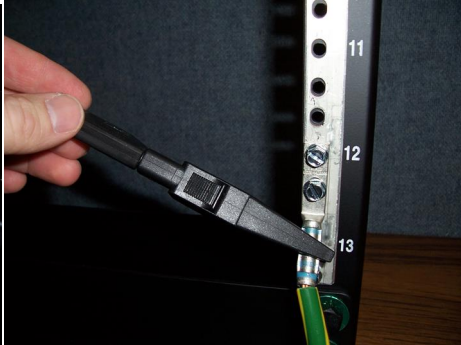
E. Bonding inspections for each cabinet: Cabinet Number _____

<p>Are electrostatic discharge (ESD) wrist strap ports available on the front and back of each cabinet?</p>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<p>Are two-hole compression lugs compression HTAPs used wherever possible?</p>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<p>Using a two-point resistance meter, measure the DC resistance between the common bonding network (CBN) to rack jumper and the HTAP connecting the jumper to the mesh common bonding network as shown below.</p> <p>One probe on the CBN jumper: </p> <p>One probe on the HTAP: </p> <p>Is the DC resistance $\leq 0.1\Omega$?</p>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<p>Using a two-point resistance meter, measure the DC resistance between equipment mounting rails and the common bonding network jumper.</p> <p>Is the DC resistance $\leq 0.1\Omega$ for each equipment mounting rail?</p>	<input type="checkbox"/> Yes <input type="checkbox"/> No

Using a two-point resistance meter, measure the DC resistance between the mounting flange of each piece of powered equipment and the common bonding network to rack jumper.	<input type="checkbox"/> Yes <input type="checkbox"/> No
Is the DC resistance $\leq 0.1\Omega$ for each piece of equipment?	

F. Bonding inspections for shielded cables: Rack/Cabinet Number _____



Has the bay passed all the rack or cabinet bonding inspections?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Using a two-point resistance meter, measure the DC resistance between each cable shield and the common bonding network (CBN) to rack jumper as shown below.	<input type="checkbox"/> Yes <input type="checkbox"/> No
<p>One probe on the shield:</p>  <p>One probe on the CBN jumper:</p> 	
Is the DC resistance $\leq 0.1\Omega$ between each module and the CBN rack jumper?	

END OF SECTION

SECTION 27 0528 – PATHWAYS FOR COMMUNICATIONS SYSTEMS

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.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.2 SUMMARY

- A. This section includes the minimum requirements for communications cable pathway installations.
 - 1. Horizontal Cable Routing
 - 2. Products
 - 3. Common Requirement for Communications Installations
 - 4. Separation from EMI Sources
 - 5. Wire Mesh Cable Tray
 - 6. Sleeve Installation for Communications Penetrations
 - 7. Penetration of Building Surfaces
 - 8. Cutting and Patching
 - 9. Retrofit-Cutover

1.3 REFERENCE STANDARDS AND CODES

- A. See Section 270513.

1.4 HORIZONTAL CABLE ROUTING

- A. All horizontal cables shall not exceed 90 m from the telecommunications outlets in the work area to the horizontal cross connect.
- B. Consolidation points shall not be used.
- C. Horizontal pathways shall be installed or selected such that the minimum bend radius of horizontal cables is kept within manufacturer specifications both during and after installation.
- D. In open ceiling cabling, cable supports shall be provided by means that is structurally independent of the suspended ceiling, its framework, or supports. These supports shall be

spaced no more than 1.5 m apart. NOTE: Cable tie-downs should maintain a minimum distance of 0.6 m apart when within 5 m of the termination point. Contact Owner to get project specific requirements on use of "J-hooks" and/or "Bridle Rings".

- E. For voice or data applications, 4-pair copper balanced twisted-pair cables shall be run using a star topology from the telecommunications room serving that floor to every individual information outlet. The Owner prior to installation of the cabling shall approve all cable routes.
- F. The Contractor shall observe the bend radius and pulling strength requirements of the 4 pair copper balanced twisted-pair optic cable during handling and installation.
- G. Each run of 4-pair copper twisted-pair cable between horizontal portions of the cross-connect in the telecommunication closet and the information outlet shall not contain splices.
- H. In a false ceiling environment, a minimum of 75 mm shall be observed between the cable supports and the false ceiling.
- I. Continuous conduit runs installed by the contractor should not exceed 30.5 m or contain more than two (2) 90 degree bends without utilizing appropriately sized pull boxes.
- J. All horizontal pathways shall be designed, installed and grounded to meet applicable local and national building and electrical codes.
- K. The number of horizontal cables placed in a cable support or pathway shall be limited to a number of cables that will not cause a geometric shape of the cables to be altered. Under no circumstances should cables in the horizontal pathway be bundled. This is to minimize "alien" cross talk.
- L. Maximum conduit pathway capacity shall not exceed a 40% fill. However, perimeter and furniture fill ratio is limited to 60% fill for moves, adds and changes.
- M. Horizontal distribution cables shall not be exposed in the work area or other locations with public access.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.2 SUBMITTALS

- A. See Section 270513.

2.3 CABLE PATHWAYS

- A. Cable Support: NRTL labeled and designed to prevent degradation of cable performance and pinch points that could damage cable. Also to be installed independently of "Other Trades" support system.
 - 1. Wire Mesh Cable Tray

2. Support brackets with cable tie slots for fastening cable ties to brackets.
 3. Lacing bars, spools, J-hooks, and D-rings.
 4. Straps and other devices.
- B. Approved manufacturers:
1. Snake Tray
 2. Cooper B-Line
 3. Chatsworth Products, Inc. (CPI)
 4. Cope
 5. Similar products, after approval by Owner

2.4 SLEEVES FOR PATHWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends, with plastic bushings.
- B. Sleeves for Rectangular Openings: Galvanized sheet steel.
1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.5 GROUT

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

2.6 FIRESTOPPING

- A. Subject to compliance with requirements, provide products of one of the following manufacturers
1. Hilti Firestop Systems
 2. 3M, Electrical Products Division, St. Paul, Minnesota
 3. Metacaulk; Rectorseal Corp., Houston, Texas
 4. Specified Technologies Inc., Somerville, New Jersey
 5. United States Gypsum Company

- B. Provide materials classified by UL to provide fire barrier equal to time rating of construction being penetrated.
- C. Provide asbestos free materials that comply with applicable Codes and have been tested in accordance with UL 1479 or ASTM E 814.
- D. Fire Rated Cable Pathways: Device modules comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill, the following products are acceptable
 - 1. Specified Technologies Inc. (STI) EZ-PATH™ Fire Rated Pathway
 - 2. Or equivalent product from different manufacturer, after approval by Owner.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.
- C. Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- D. Right of Way: Give to piping systems installed at a required slope.

3.2 SEPARATION FROM EMI SOURCES

- A. Comply with TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
- B. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - 1. Electrical Equipment Rating Less than 2 kVA: A minimum of 5 inches
 - 2. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - 3. Electrical Equipment Rating More than 5 kVA: A minimum of 24 inches
- C. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - 1. Electrical Equipment Rating Less than 2 kVA: A minimum of 2-1/2 inches
 - 2. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - 3. Electrical Equipment Rating More than 5 kVA: A minimum of 12 inches

- D. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - 1. Electrical Equipment Rating Less than 2 kVA: No requirement
 - 2. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - 3. Electrical Equipment Rating More than 5 kVA: A minimum of 6 inches
- E. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or higher: A minimum of 48 inches.
- F. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.3 WIRE MESH CABLE TRAY

- A. Provide all components of the tray system (tray, supports, splices, fasteners and accessories) from a single manufacturer.
- B. Supports will be sized at minimum to match the width of the wire mesh cable tray that is supported. The support may be wider than wire mesh cable tray.
- C. Wire mesh cable tray shall be secured independently to the structural ceiling, building truss system, wall or floor using manufacturer's recommended supports and appropriate hardware as defined by local code or the authority having jurisdiction (AHJ).
- D. When the pathway is overhead, wire mesh cable tray shall be installed with a minimum clearance of 12" above the tray. Leave 12" in between the tray and ceiling/building truss structure. Multiple tiers of wire mesh cable tray shall be installed with a minimum clearance of 12" in between the trays. When located above an acoustical drop ceiling, wire mesh cable tray shall be installed a minimum of 3" above the drop ceiling tiles.
- E. When installed under a raised floor, wire mesh cable tray shall be installed with a minimum $\frac{3}{4}$ " clearance between the top of the tray and the bottom of the floor tiles or floor system stringers, whichever are lower in elevation. Maintain a 3" clearance between trays wherever trays cross over.
- F. Wire mesh cable tray shall be supported by manufacturer's specifications. Support wire mesh cable tray on both sides of every change in elevation.
- G. Wire mesh cable tray shall be labeled with a sign along its side (6 inches by 12 inches) that states the Telecommunications Room that it serves and shall point to the direction of the nearest telecommunications room that it serves, spaced at intervals of every 25 feet with footage markers showing the total footage in reference to the Telecommunications Room that it serves.
- H. Secure wire mesh cable tray to each support with a minimum of one (1) fastener. Follow the manufacturer's recommended assembly, splice and intersection-forming practices.
- I. Use installation tools recommended by the manufacturer to field fabricate wire mesh cable tray intersections and changes in elevation. Use shear cutters to cut wire mesh cable tray. Use a bending tool to form the ends of cut sections downward at 90° to allow easy drop-in installation with approved supports.

- J. Wire mesh cable tray shall be bonded to the Telecommunications Grounding Busbar (TGB) using an approved ground lug on the wire basket tray and a minimum #6 grounding wire or as recommended by the AHJ. Verify bonds at splices and intersections between individual cable tray sections and supports. Cable pathway should be electrically continuous through bonding and attached to the TGB.
- K. The quantity of cables within the tray will not exceed a whole number value equal to 50% of the interior area of the tray divided by the cross-sectional area of the cable. Cable fill will not exceed the depth of the cable tray's side rail (2", 4" or 6").
- L. The combined weight of cables within the tray will not exceed stated load capacity in manufacturer's specifications.
- M. Separate different media type within the tray. Treat each type of media separately when determining cable fill limits.
- N. When pathways for other utilities or building services are within 2' of the wire mesh cable tray, cover the tray after cables are installed.

3.4 SLEEVE INSTALLATION FOR COMMUNICATION PENETRATIONS

- A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Each pipe sleeve, horizontal or vertical, shall have a plastic type "end-bushing" on both ends to protect cables from abrasion when pulled through sleeves. The "end-bushing" shall be installed prior to install cables through sleeve.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both surfaces of walls with respect to plastic "end-bushings". The plastic "end-bushing" shall be plenum rated if applied in plenum space.
- G. Extend sleeves installed in floors 2 inches above finished floor level with respect to plastic "end-bushings". The plastic "end-bushing" shall be plenum rated if applied in plenum space.
- H. Size pipe sleeves to provide ¼" annular clear space between sleeve and pathway or cable, unless indicated otherwise.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable

penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

- L. Roof-Penetration Sleeves: Weather seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

3.5 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- C. Provide sleeves for new conduit and cable penetrations of building construction.
 - 1. Openings to accept sleeves in new building construction will be formed in building construction by the Contractor for General Construction work. Openings to accept sleeves in existing building construction shall be provided under this division of the Specifications. Refer to Article, CUTTING AND PATCHING in this Section.
 - 2. Use galvanized rigid conduit sleeves for penetrations through exterior masonry/concrete walls and foundations, concrete floor slabs on grade and above grade, and concrete-filled decks.
 - 3. Use only fire-rated listed assemblies for the type of sleeve being installed through CMU walls or gypsum walls for communications penetrations. Sleeve type shall be galvanized rigid conduit.
- D. Where conduits are installed before building construction being penetrated, install sleeves loose around conduits. Split, fit, and weld steel sleeves over existing conduits, with respect to anything flammable in the surrounding environment.
- E. Secure sleeves firmly in place using filling and patching materials (grout) that match with surrounding construction.
- F. In floor penetrations, extend sleeve 4" above finished floor unless noted otherwise. In wall penetrations, cut sleeves flush with wall surface and use metal escutcheon plates in finished interior areas.
- G. Seal voids between sleeves and building construction with joint sealants. Make allowances for and coordinate the Work with installation of firestopping, conduit insulation, and waterproofing as applicable.
- H. The Contractor shall be fully responsible for final and correct location of sleeves. Sleeves which are omitted or incorrectly located in existing building construction, shall be corrected and provided by the Communications Contractor, at no additional costs to the Owner.

3.6 PENETRATION OF BUILDING SERVICES

- A. Above Grade Level or Non-waterproof Areas
 - 1. Seal each annular space between conduits or cable and building surfaces. Pack space

with Oakum, other rope packing, or backer rod materials and cover with fire-resistant sealant or other protection materials.

2. Provide sleeves as specified in Article, SLEEVE-SEAL INSTALLATION in this Section for conduit and cable penetrations. Seal each space between conduit or cable and sleeve. Sealing shall be as specified in above paragraph.

B. Waterproof Areas (Above and Below Grade)

1. In new and existing construction for penetration through concrete below grade, ground water level, or in other waterproof areas, provide through-wall and floor seals having galvanized fittings, sealing assemblies, and sleeves as specified.
2. In existing construction when core bore drilled openings are used for conduit penetrations below grade, ground water level, or in other waterproof areas, provide sealing.

C. Fire-resistant Areas

1. Provide through-penetration firestop systems for penetrations through fire-rated walls, floors, and other partitions of building construction. Comply with requirements in Division 07 Section "Penetration Firestopping."
2. In walls or partitions with 2-hour or less fire ratings, provide only metallic outlet or device boxes installed per UL Fire Resistance Director, NEC, and other national building code requirements.

3.7 CUTTING AND PATCHING

- A. Provide openings, cutting, coring, and patching of openings in existing building construction as required. Patching includes openings and voids left in existing construction as a result of demolition.
- B. The Work shall include necessary assemblies and materials to maintain required fire ratings.
- C. Perform cutting as to not impair structural stability of building construction and system. Do not drill holes or weld attachments to beams and other structural members without prior written approval from the Owner's Representative. Contact the Engineer-of-Record for guidance.
- D. The Work shall be done by a craftsperson skilled in the particular trades affected.
- E. Patching materials shall match existing materials in type and quality. Patching shall be done in a manner to match appearance of adjacent surfaces.

3.8 RETROFIT-CUTOVER

- A. Furnish equipment, materials, labor and services, and perform operations required to retrofit/cutover existing cabling systems. Removals shown are general indications and may not indicate full extent of removals which may be required to complete Work.
- B. Furnish equipment, materials, labor and services, and performing operations required to enable continued functioning of existing system until cutover to new system.

- C. Remove wiring, punch blocks, cabinets, outlets, raceways, and equipment not required for new system.
 - 1. Abandon flush mounted device and junction boxes and cover with blank plate to match the current room décor.
 - 2. Remove surface telecommunications outlets and pathways unless said removal will damage the existing finish on surfaces, or physically damage the structure.
 - 3. Remove wiring from abandoned conduits and raceways from the work area outlet back to the corresponding termination point in the Telecommunication Room. Place a trailer string in vacated conduits and raceways.
 - 4. Remove labeling at both ends for abandoned cables/wiring.
 - 5. The collected abandoned cables/wiring shall be collected and removed from site by Contractor.
- D. Perform the work in neat and workmanlike manner in accordance with the applicable codes, standards and AHJ.
- E. Removal and replacement of existing ceilings:
 - 1. Carefully remove existing ceilings as required to perform the work. Store removed tiles in an area designated by the Owner. Modify and augment existing suspension systems as necessary. Restore ceiling systems to their original finish.
 - 2. Repair any damage to ceilings due to modifications, removal, and replacement of same. Replace damaged ceiling tiles, including tiles with holes or openings left as a result of demolition, with materials of like kind.
- F. Existing equipment or material shall not be reused without specific approval of the Owner's Representative except as noted below:
 - 1. Existing cable terminal housings may be reused if in good condition.
- G. Equipment and materials to be removed and not desired by the Owner shall be removed from site promptly.
- H. Equipment and material to be removed and that is desired by the Owner shall be moved to an on-site storage location as directed by the Owner.

3.9 FIRESTOPPING

- A. Performance Requirements
 - 1. Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur.
 - 2. Where non-mechanical products are utilized, provide products that upon curing do not re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during or after construction.

3. Where it is not practical to use a mechanical device, openings within floors and walls designed to accommodate telecommunications and data cabling shall be provided with re-enterable products that do not cure or dry.
4. Openings for cable trays shall be sealed using re-enterable firestopping pillows.

B. Quality Assurance

1. Product/Systems: Provide firestopping systems that comply with the following requirements:
 - a. Firestopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is UL, or another agency performing testing and follow-up inspection services for firestop system acceptable to authorities having jurisdiction.
 - b. Firestopping products bear the classification marking of qualified testing and inspection agency.
 - c. Installer Qualifications: Experience in performing work of this section who is qualified by the firestopping manufacturer as having been provided the necessary training to install firestop products in accordance with specified requirements.

C. Project Conditions

1. Do not install firestopping products when ambient or substrate temperatures are outside limitations recommended by manufacturer.
2. Do not install firestopping products when substrates are wet due to rain, frost, condensation, or other causes.
3. Maintain minimum temperature before, during and for a minimum three (3) days after installation of materials.
4. Do not use materials that contain flammable solvents.
5. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
6. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
7. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

END OF SECTION

SECTION 27 0553 – IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the following systems identification indicated by the Contract Documents with supplementary items necessary for proper installation.
- B. The contractor shall develop and submit for approval a labeling system for the structure cabling installation. The Owner will negotiate an appropriate labeling scheme with the successful contractor. At a minimum, the labeling system shall clearly identify all components of the structured cabling system: racks, cables, panels and outlets. The labeling system shall designate the cables origin and destination and a unique identifier for the cable within the system. Racks and patch panels shall be labeled to identify the location within the structured cable system infrastructure. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.

1.2 REFERENCES

- A. Several industry standards define the identification of the network physical infrastructure. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:
 - 1. TIA-942 Telecommunications Infrastructure Standard for Data Centers
 - 2. TIA/EIA-606B Administration Standard for Telecommunication Infrastructure
 - 3. NFPA 70E-2004 Standard for Electrical Safety in the Workplace
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1.3 SUBMITTALS

- A. Product Data: The Contractor shall submit catalog cut-sheets that include manufacturer, trade name, and complete model number for each product specified. Model number shall be handwritten and/or highlighted to indicate exact selection. Identify applicable specification section reference for each product.
- B. Qualification Data: For firms and person specified in "Quality Assurance" Article.

1.4 QUALITY ASSURANCE

- A. Provided products shall meet the following requirements: Items of the same classification shall be identical. This requirement includes equipment, assemblies, parts and components.
- B. Assure that the "as installed" system is correctly and completely documented including engineered drawings, manuals, and operational procedures in such a manner as to support maintenance and future expansion of the system.

- C. Materials and equipment: Equipment shall be rated for continuous operation under the ambient environmental temperature, humidity, and vibration conditions encountered at the installed location. The equipment shall meet the following requirements:
1. Interior controlled environment: 60 to 100 degrees F dry bulb and 20 to 90 percent relative humidity, non-condensing.
 2. Interior uncontrolled environment: 0 to 130 degrees F dry bulb and 10 to 95 percent relative humidity, non-condensing.
 3. Exterior environments: Minus 30 degrees to 130 degrees F dry bulb, and 10 to 100 percent relative humidity, condensing.
 4. Hazardous environment: All system components located in areas where fire or explosion hazards may exist because of flammable gas or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings, shall be rated and installed according to Chapter 5 of the NEC and as shown.
 5. Listing and Labeling: Provide products specified in this Section that are listed and labeled, as defined in the NEC Article 100.

PART 2 - PRODUCTS

2.1 EQUIPMENT TYPE

- A. All label printing will be machine generated by Panduit Easy-Mark labeling software and Panduit desktop and hand-held printers using indelible thermal transfer ribbons or cartridges. Panduit self-laminating labels or Turn-Tell™ labels will be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end. Outlet, patch panel and wiring block labels shall be installed on, or in, the space provided on the device.
1. Computer Printable Labels
 - a. Machine generated labels provide clear communication. Labels are designed for specific data center infrastructure applications insuring a proper fit and long life.
 - b. Data cables shall be identified with self-laminated cable markers that can be rotated for visibility from any angle, and allow repositioning on the cable to align legends for improved aesthetics (Turn-Tell Labels).
 - c. Cabinets and equipment shall be identified with thermal transfer printed, die-cut, microcellular foam with a polyester printable surface and high-tack adhesive (Raised Panel Labels).
 - d. Fiber Optic cables shall be identified with non-adhesive, thermal transfer printable, flag style markers that permit the repositioning of the marker for greater visibility and improved aesthetics (Flag Labels).
 - e. Cable bundle shall be identified with non-adhesive thermal transfer printable marker plates attached with nylon cable ties or hook and loop ties. Marker plates shall offer crisp, clear legends and shall meet requirements for MIL-STD-202G, Notice 12 Method 215J (Thermal Transfer Printable Marker Plates).
 2. Easy-Mark Labeling Software
 - a. The Labeling Software insures that data center infrastructure identifiers conform to applicable Standards.

- b. Labels and identifiers shall be produced with labeling software that guides the user through the process of creating labels used throughout the data center providing faster and more reliable infrastructure identification (Easy-Mark Labeling Software).
 - c. Labels and identifiers shall be produced with labeling software that facilitates quick and easy extraction of identifiers from CAD drawings saving time and reducing errors caused by manual entry of data into labeling software (CAD-Connect Labeling Software)
- 3. LS8EQ Portable Printing System
 - a. The LS8EQ printer produces durable, clear identification labels on site.
 - b. Labels and identifiers shall be printed on hand-held thermal transfer printer increasing labeling productivity. Printer labels shall be contained in fast loading label cassette containing an integrated memory device for automatic formatting, recall of last legend and number of labels remaining on the cassette. The printer shall provide a partial cut feature to allow the flexibility of tear-apart strips of labels for quicker installation.
 - c. Labels and identifiers shall be printed on a compact and rugged portable thermal transfer printer that fits in one hand. The printer shall have a large, backlit display, QWERTY keyboard, USB interface for importing data and printing labels from a wireless laptop or desktop computer. Printer shall simplify the creation of labels for network components through built-in data center labeling tools. Printer labels shall be contained in fast loading label cassette containing an integrated memory device for automatic formatting, recall of last legend and number of labels remaining on the cassette. The printer shall provide a partial cut feature to allow the flexibility of tear-apart strips of labels for quicker installation (LS8EQ).
- 4. Physical Network Security Devices
 - a. Physical Network Security devices insure that network connection points are protected from unauthorized or unintended access or disconnection.
 - b. RJ45 Plug Lock In Device
 - c. RJ45 Plug Block-out Device
- 5. Facility Safety Signs
 - a. Provide clear, concise communication of facility hazards and infrastructure mechanical systems.
 - b. Snap-on Pipe Markers
- 6. Electrical Safety Signs
 - a. Clearly define electrical hazards and power paths.
 - b. Arc Flash Warning Signs

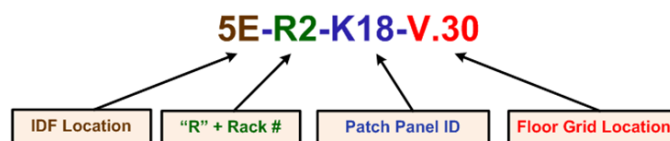
2.2 ACCEPTABLE MANUFACTURERS

- A. Panduit (Basis of Design)

PART 3 - EXECUTION

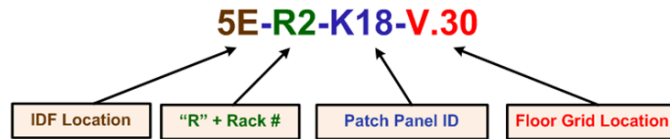
3.1 INSTALLATION

- A. TIA/EIA-606-B: Four (4) classes of administration are specified in the standard, to accommodate diverse degrees of complexity present in the telecommunications infrastructure. The specifications for each class include requirements for identifiers, records, and labeling.
- Class 1: Address the administration needs of a premises that is served by a single telecommunications space (TS) containing its telecommunications equipment. Required in Class 1 administration are identifiers for the TS, cabinets or racks, patch panels and termination blocks, ports or termination block positions, patch cables, cabling subsystem 1 links or horizontal links, equipment and workspace outlets, consolidation points, zone enclosures, splices, and all telecommunications grounding and bonding systems.
- B. Telecommunication Space Labeling
- Each TS should be identified with a scheme that defines the location of the space. The location should be defined with the floor and room number or other room designation. A typical telecommunication space would have the following scheme: 1DC2. This identifier would defined that this is DATA CENTER 2 LOCATED ON THE FIRST FLOOR OF THE BUILDING.
- C. Component Locations in the Telecommunications Space
- Locations for components in the TS can be determined either by using the grid coordinates for the space or assigning unique numbers to the various cabinet and wall segments in the space.
- D. Grid Labeling
- Component locations in a TS are determined using an X-Y coordinate system that is usually based on the floor tile system in the data center space. Using alphabetic designations on one axis of the room and numerical designations on the other axis of the room create a series of alphanumeric designations that can be established for each floor tile in a data center space. These floor tile designations are the basis for determining the location of data center devices.
- E. Workstation Labeling
- The labeling of the data outlets should correspond with the label on the patch panel in the IDF/MDF room. The label format should follow this structure:
 - Every jack module must be labeled according to this standard. The letters "I" and "O" are skipped to avoid confusion with the numbers "1" and "0" respectively.



F. Labeling

1. The labeling of the horizontal cabling should correspond with the label on the outlet and the patch panel. This horizontal link identifier, unique within the building, shall be used for every horizontal cable. Follow the below labeling format:

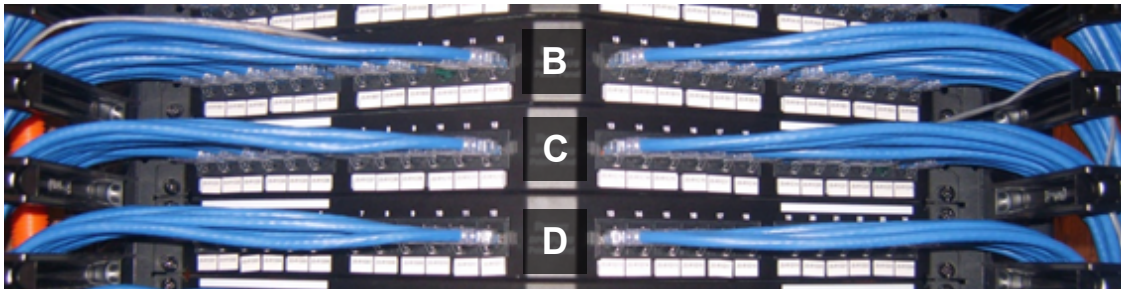


Note: The letters "I" and "O" are skipped to avoid confusion with the numbers "1" and "0" respectively.

G. Patch Panel Type and Labeling

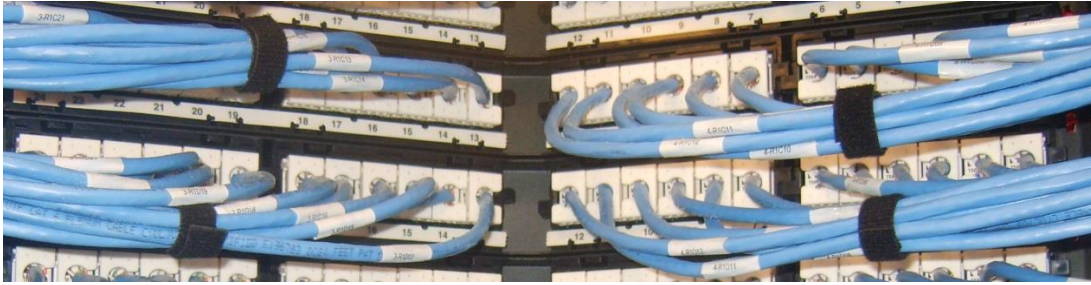
1. Nationwide requires the use of 24-port angled modular patch panels as specified in Appendix C. The patch panels should be labeled from top to bottom with the letters: A, B, C, D, E, F, G, H, J, K, L, M, N, P, Q, R (notice: the letters "I" and "O" are skipped to avoid confusion with the numbers "1" and "0" respectively).
2. The label on each patch panel port should match the label on telecommunications outlet.
3. There should not be any spaces in the rack between the patch panels.
4. The label underneath each patch panel port should include floor identifier and the workstation grid coordinates. Above each port is the manufacturer's pre-printed port number which matches the cable label on the back of the port as well as the label at the cube location (section 2.4).

Patch Panel Front View



The horizontal cables should be labeled on the backside of the patch panel so that the label on the cable matches the label on the front of the patch panel.

Patch Panel Rear View



Patch Panel Rear View (Close Up)



H. Cabinet/Rack Labeling

1. The floor tile designations are used to identify each cabinet or rack in the data center. The cabinet/rack location is based on which floor tile the right front corner of the cabinet/rack rests upon. Cabinets and racks should have location labels applied to the top and bottom of both the front and rear of the device. These labels should be visible whether or not doors are closed or opened on the cabinets.
2. A typical cabinet/rack label would have the following scheme: AB04. This identifier would define that the cabinet/rack is located with its RIGHT FRONT CORNER AT THE INTERSECTION OF ROW AB AND COLUMN 04.
3. Cable/Rack Label Recommendation:

Printer Type	Laser/Inkjet	LS8E	Desktop Thermal
Label Area	2.00 x 1.00	2.00 x 1.00	2.00 x 1.00
Label P/N	C200X100YJJ	C200X100YPC	C200X100YPT C200X100APT C200X100AMT

I. Panel Labeling

1. Once the cabinet/rack identifiers are established then the various panels in the cabinet/rack should be identified. The designation for the panel positions in a cabinet/rack can be either an alphabetic designation or a two-digit number that represent the rack unit number (RU) where the top-left mounting screw lands in the cabinet/rack. Using the RU method provides the data center manager with greater flexibility since it allows for panels and equipment to be added or removed later and not disrupt the designation of panel identifiers.



2. A typical panel label would have the following scheme: AB04-24. This identifier would define that the top left mounting screw of the panel is located at the 24th rack unit position in the cabinet/rack located grid AB04 in the data center.
3. Panel Label Recommendation:

Printer Type	Laser/Inkjet	LS8E	Desktop Thermal
Label P/N	C100X050YJJ	C100X050YPC	C100X050APT C100X050A0T

J. Port Labeling

1. Port identifiers are very important in that they will define the connectivity of cabling within the data center infrastructure. Many patch panels come from the factory with numbers already screen-printed above the ports. If this is the case then there is no need to re-label those patch panels. If the patch panels are not pre-printed with port numbers then labels will need to be created to identify the port numbers. The numbering sequence should proceed from left to right and top to bottom for all ports on a patch panel. The number of digits used for all numbers on a patch panel should be consistent with the total number of ports on that patch panel. For example a 48-port patch panel should be labeled 01 through 48 and a 144-port patch panel should be labeled 001 through 144.



2. A typical port label would have the following scheme: AB04-24:12. This identifier can be decoded to define that this port 12 located on panel 24 in cabinet/rack AB04. This is

somewhat redundant information given that the cabinet/rack and panel are clearly identified and are not usually required information on the port label since the cabinet/rack and panel are apparent to the viewer who is standing at the location of the port. Therefore, a typical port label would have the following scheme: 12. This identifier defines that this is port 12.

3. Port Label Recommendations:

Printer Type	Laser/Inkjet				
Cable Type	Copper	Copper	Copper	Copper	Fiber
Label Style	Adhesive	Adhesive	Non-Adhesive	Non-Adhesive	Adhesive
Number of Ports	4	6	4	6	n/a
Label P/N	C261X030FJJ	C379X030FJJ	C261X035Y1J	C390X030Y1J	C350X100YJJ

Printer Type	LS8E				
Cable Type	Copper	Copper	Copper	Copper	Fiber
Label Style	Adhesive	Adhesive	Non-Adhesive	Non-Adhesive	Adhesive
Number of Ports	4	6	4	6	n/a
Label P/N	C252X030FJC	C379X030FJC	C261X035Y1C	C390X030Y1C	T100X000YPC-BK

Printer Type	Desktop Thermal		
Cable Type	Copper	Copper	Fiber
Label Style	Adhesive	Adhesive	Adhesive
Label P/N	C252X030YPT C252X030APT	C379X030YPT C379X030APT	C350X100YJT

K. Cable Labeling and Patch Cord Labeling

1. Cabling on the back and front of the cabinet/rack must be identified. Labeling of cables on the back of the panel is considered cable labeling and the labeling of cables connected to the front of the patch is considered patch cord/equipment cord labeling.
2. Cable labels are identified with information that defines the connection between the near end panel connection and the far end panel connection. A near end connection identifier would consist of the cabinet/rack location, panel location, and port location. The far end connection identifier would consist of the cabinet/rack location, panel location and port location.



- a. A typical cable label would have information in the following scheme: AB04-24:01/AB07-36:13. This identifier would be decoded to define the cable connects between cabinet AB04 panel 24 port 01 going to cabinet AB07 panel 36 port 13. The far end of the cable would have a label that would have the same but with the information reversed.
- b. Recommended Cable Labels:

Printer Type	Laser/Inkjet	Laser/Inkjet	Laser/Inkjet	Laser/Inkjet	Laser/Inkjet
Cable Type	Copper	Copper	Fiber	Fiber	Fiber
Cable Diameter	Cat5/5e/6	10G UTP/STP	2mm/3mm	Duplex 3mm	Dia (0.24" to 0.48")
Marker Type	Self-Laminating	Self-Laminating	Flag	Flag	Self-Laminating
Label P/N	S100X150YAJ	S100X225YAJ	F102X220FJJ	F102X220FJJ	S100X225YAJ

Printer Type	LS8	LS8	LS8	LS8	LS8
Cable Type	Copper	Copper	Fiber	Fiber	Fiber
Cable Diameter	Cat5/5e/6	10G UTP/STP	2mm/3mm	Duplex 3mm	Dia (0.24" to 0.48")
Marker Type	Self-Laminating	Self-Laminating	Self-Laminating for Label-Core	Self-Laminating for Label-Core	Self-Laminating
Label P/N	S100X150VAC R100X150V1C	S100X225VAC R100X150V1C	S100X160VAC	S100X220VAC	S100X225VAC

Printer Type	Desktop Thermal	Desktop Thermal	Desktop Thermal
Cable Type	Copper	Copper	Fiber
Cable Diameter	Cat5/5e/6	10G UTP/STP	Dia (0.24" to 0.48")
Marker Type	Self-Laminating	Self-Laminating	Self-Laminating
Label P/N	S100X150VAT R100X150V1T	S100X225VAT R100X225V1T	S100X225VAT R100X225V1T

3. Patch Cord/Equipment Cord Labels are identified with information that defines the connection between the near end patch panel front connections and the far end patch panel front connections or equipment connections. A near end connection identifier

would consist of the cabinet/rack location, panel location, and port location. The far end connection identifier would consist of the cabinet/rack location, panel location, and port location.



- a. A typical patch cord label would have information in the following scheme: AB04-24:12\AB04-36:24. This identifier would be decoded to define the patch cord connection between cabinet AB04 panel 24 port 12 going to the same cabinet panel 36 port 24. The far end of the cable would have a label that would have the same but with the information reversed.
- b. A typical equipment cord label would have information in the following scheme: AB04-24:01\AB04-Tinley2:A. This identifier would be decoded to define the equipment cord connection between cabinet AB 04 panel 24 port 01 going to the same cabinet port A on equipment named Tinley2. Rack unit location could be substituted for equipment name if necessary.
- c. Recommended Patch/Equipment Cord Labels:

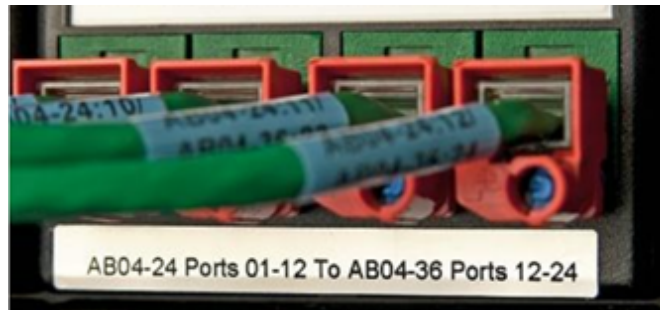
Printer Type	Laser/Inkjet	Laser/Inkjet	Laser/Inkjet	Laser/Inkjet	Laser/Inkjet
Cable Type	Copper	Copper	Fiber	Fiber	Fiber
Cable Diameter	Cat5/5e/6	10G UTP/STP	2mm/3mm	Duplex 3mm	Dia (0.24" to 0.48")
Marker Type	Self-Laminating	Self-Laminating	Flag	Flag	Self-Laminating
Label P/N	S100X150YAJ	S100X225YAJ	F102X220FJJ	F102X220FJJ	S100X225YAJ

Printer Type	LS8	LS8	LS8	LS8	LS8
Cable Type	Copper	Copper	Fiber	Fiber	Fiber
Cable Diameter	Cat5/5e/6	10G UTP/STP	2mm/3mm	Duplex 3mm	Dia (0.24" to 0.48")
Marker Type	Self-Laminating	Self-Laminating	Self-Laminating for Label-Core	Self-Laminating for Label-Core	Self-Laminating
Label P/N	S100X150VAC R100X150V1C	S100X225VAC R100X150V1C	S100X160VAC	S100X220VAC	S100X225VAC

Printer Type	Desktop Thermal	Desktop Thermal	Desktop Thermal
Cable Type	Copper	Copper	Copper
Cable Diameter	Cat5/5e/6	10G UTP/STP	Dia (0.24" to 0.48")
Marker Type	Self-Laminating	Self-Laminating	Self-Laminating

Label P/N	S100X150VAT R100X150V1T	S100X225VAT R100X225V1T	S100X225VAT R100X225V1T
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4. Patch Panel Connectivity defines the connections between the near-end ports and the far-end ports. This labeling can define the connection of a range of ports on a panel or just define the connection for two (2) individual ports.



- a. A typical patch panel connectivity label would have the following scheme: AB04-24: ports 01-12/AB04-36: ports 12-24. This identifier would describe that ports 01 through 12 on panel 24 of cabinet AB04 connect to ports 12 through 24 on panel 36 of cabinet AB04.
- b. Recommended Patch Panel Connectivity Labels:

Printer Type	Laser/Inkjet		
Media	Copper	Copper	Fiber
Ports	4 or less	More than 4	n/a
Label P/N	C252X030FJJ	C379X030FJJ	C350X100YJJ

Printer Type	LS8		
Media	Copper	Copper	Fiber
Ports	4 or less	More than 4	n/a
Label P/N	C252X030FJC	C379X030FJC	T100X000VJC-BK

Printer Type	Desktop Thermal		
Media	Copper	Copper	Fiber
Ports	4 or less	More than 4	n/a
Label P/N	C252X030YPT	C379X030YPT	C350X100YJT

L. Labeling for Other Systems

1. In addition to the data connections there are many other systems in a data center that require labeling.

3.2 GROUNDING AND BONDING

- A. Labeling of the grounding and bonding system involves the identification of the main grounding busbar, grounding busbars, conductors connecting busbars, conductors connecting devices to busbars, and equalizing conductors.

1. The typical scheme for the main grounding busbar would be: 1-B301-TMGB. This identifier can be decoded to define that this is the main telecommunications grounding busbar located on Floor 1 in Space B301.

2. The typical scheme for a grounding busbar would be: 2-R201-TGB. This identifier can be decoded to define that this is the telecommunications grounding busbar on Floor 2 in Space R201.

- a. Recommended Telecommunications Grounding Busbar Labels

Printer Type	Laser/Inkjet	LS8	Desktop Thermal
Label P/N	C400X200YJJ	C200X100YPC	C400X200YPT

3. The typical scheme for the busbar connections would be: 1-B301-TMGB/2-R201-TGB. This identifier can be decoded to define that this is the conductor that connects the main telecommunications grounding busbar located on Floor 1 in Space B301 to the telecommunications grounding busbar on Floor 2 in Space R201.

- a. Recommended Busbar Connections Labels

Printer Type	Laser/Inkjet				
Cable Diameter	18-14 AWG	12-10 AWG	8-4 AWG	2-1 AWG	1/0-250 MCM
Marker Type	Self-Laminating	Self-Laminating	Self-Laminating	Self-Laminating	Self-Laminating
Label P/N	S100X075YAJ	S100X125YAJ	S100X225YAJ	S100X400YAJ	S100X650YAJ

Printer Type	LS8				
Cable Diameter	18-14 AWG	12-10 AWG	8-4 AWG	2-1 AWG	1/0-250 MCM
Marker Type	Self-Laminating	Self-Laminating	Self-Laminating	Self-Laminating	Self-Laminating
Label P/N	S100X075VAC	S100X125VAC	S100X225VAC	S100X400VAC	S100X650VAC

Printer Type	Desktop Thermal				
Cable Diameter	18-14 AWG	12-10 AWG	8-4 AWG	2-1 AWG	1/0-250 MCM
Marker Type	Self-Laminating	Self-Laminating	Self-Laminating	Self-Laminating	Self-Laminating
Label P/N	S100X075VAT	S100X125VAT	S100X225VAT	S100X400VAT	S100X650VAT

END OF SECTION

SECTION 27 0800 – WARRANTY OF STRUCTURED CABLING

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the Structured Cabling indicated by the Contract Documents with supplementary items necessary for proper installation and guarantee of warranty.

1.2 SUBMITTALS

- A. Product Data

1.3 QUALITY ASSURANCE

- A. Manufacturer's Warranty and Application Assurance
 - 1. The Structured Connectivity Solutions Extended Manufacturer's Warranty and Application Assurance
 - a. The extended manufacturer's warranty, for a minimum of 20 years from the date of occupancy, shall include providing replacement or repair of defective product(s) and labor for the replacement or repair of such defective product(s) for the period indicated above.
 - b. Minimum twenty (20) year application assurance: The application assurance shall cover the failure of the wiring system to support the application which it has designed to support, as well as additional application(s) introduced in the future for a minimum twenty (20) year period.
 - c. System certification: Upon successful completion of the installation and subsequent inspection, the Owner shall be provided with a numbered certificate, from the manufacturer(s), registering the installation.
 - 2. Application Assurance
 - a. The Application Assurance covers the Registered Manufacturer SCS compliant to support operations of the application(s) that the system was designed to support, as well as additional application(s) that the system was designed to support, as well as additional application(s) defined below. Manufacturer Solutions warrants that the Registered Manufacturer SCS will be free from defects that prevent operation of the specific application(s) for which the Registered Manufacturer SCS was initially designed as long as the design is in compliance with the Manufacturer SCS Performance Specifications for said applications and is in compliance with all other terms and conditions of this warranty.
 - b. The Application Assurance also covers the following additional applications:
 - 1) Those as specified in the current (at the time of installation) Manufacturer SCS Performance Specifications and Addendums; and
 - 2) In accordance with application standards specifications, any application introduced in the future by recognized standards or user forums that use the relevant TIA 568-C series or ISO/IEC 11801 components and link/channel specifications for cabling, to the extent that such applications are defined to operate over the guaranteed channel performance and/or the installed channel topologies.

3. Term of Warranty

- a. The warranty period will be for a minimum of Twenty (20) years from the date of occupancy.
- b. Moves, additions or changes are covered by the original registration certificate if performed by a Manufacturer Business Partner in compliance with the Manufacturer SCS design, installation and registration requirements.
- c. Administration of Manufacturer SCS cords by the end user is covered by the original registration certificate.

4. Person / Entity Covered

- a. This warranty is for the sole benefit of the person or entity to whom the Manufacturer Solution's registration certificate is issued and any successor in interest to the site in which such Registered Manufacturer SCS was originally installed.

B. Testing and Inspection of Communications Equipment

- 1. Provide tests specified below, when applicable, and as indicated under individual items of material, equipment, and work specified in this Specification.
 - a. Furnish all test equipment and instruments required for the tests.
 - b. Responsible, qualified employees of the contractor in the presence of the Owner or an authorized representative shall perform the cable testing.
 - c. All individuals involved in the testing phase of the project shall not have been involved in the installation phase nor shall have immediate knowledge of the installation task.
- 2. End to end performance of all parts and channels will be tested.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 27 0820 – ACCEPTANCE OF COMMUNICATIONS COPPER CABLING

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the required remote control and signal cabling indicated by the Contract Documents with supplementary items necessary for proper installation.

1.2 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references.
- C. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- D. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them. See Section 207513.

1.3 SUBMITTALS

- A. See Section 270513
- B. A schedule (list) of all copper cables to be tested.
- C. Sample test reports
- D. Copy of latest calibration report of used test equipment.

1.4 QUALITY ASSURANCE

- A. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. Appropriate training programs include but are not limited to installation certification programs provided by BICSI or the ACP (Association of Cabling Professionals). These certificates may have been issued by any of the following organizations or an equivalent organizations:
 - 1. Manufacturer of the copper cable and/or copper connectors.
 - 2. Manufacturer of the test equipment used for the field certification.
 - 3. Training organizations (e.g., BICSI, A Telecommunications Association headquarters in Tampa, Florida; ACP [Association of Cabling Professionals™] Cabling Business Institute located in Dallas, Texas)

- B. The test equipment shall be within the calibration period recommended by the manufacturer in order to achieve the manufacturer-specified measurement accuracy.
- C. The Owner or the Owner's representative shall be invited to witness and/or review field-testing.
- D. The Owner or the Owner's representative shall be notified of the start date of the testing phase five (5) business days before testing commences.
- E. The Owner or the Owner's representative will select a random sample of 10% of the installed links. The Owner or the Owner's representative shall test these randomly selected links and the results are to be stored in accordance with Part 3 of this document. The results obtained shall be compared to the data provided by the installation Contractor. If more than 2% of the sample results differ in terms of the pass/fail determination, the installation Contractor under supervision of the representative shall repeat 100% testing at no cost to the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.2 COPPER CERTIFICATION TESTERS

- A. The field-test instrument shall be within the calibration period recommended by the manufacturer.
- B. Test equipment (tester) for:
 - 1. Category 6: Test equipment shall comply with the accuracy requirements for level III field testers as defined in the TIA Cat 6 Standard.
- C. Acceptable Manufacturer
 - 1. Fluke Networks
 - 2. Or approved equal

PART 3 - EXECUTION

3.1 GENERAL

- A. Every cabling link in the installation shall be tested for
 - 1. Wire map
 - 2. Length
 - 3. Insertion Loss

4. NEXT Loss
5. PS NEXT Loss
6. ACR-F Loss
7. PS ACR-F Loss
8. Return Loss
9. Propagation Delay
10. Delay Skew

- B. End-to-end cabling will be considered defective if it does not pass tests and inspections, based on Category 5E, 6 and CAT6A performance specifications chart below.

Category 6 Performance Specifications Chart	
Parameter	Category 6
Specified Frequency Range	250 MHz
Attenuation	19.8
NEXT	44.3 dB
Power-Sum NEXT	37.1 dB
ACR	18.6 dB
Power-Sum ACR	20.3 dB
ELFEXT	27 dB
Power-Sum ELFEXT	24.8 dB
Return Loss	20.1 dB
Propagation Delay	548 nsec
Delay Skew	50 nsec
Network 5 Supported	1000 Base-TX

- C. Alien Crosstalk testing is not required. Please get confirmation hereof from the Owner before testing.
- D. The installed twisted-pair horizontal links shall be tested from the Telecommunications Room to the wall outlet in the work area.
- E. The test plug shall fall within the values specified in the applicable standard (CAT6) for NEXT Loss, FEXT Loss and Return Loss.
- F. The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester than

can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The Contractor shall provide proof that the interface has been calibrated within the period recommended by the vendor. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.

- G. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter. The test result of a parameter shall be marked with an asterisk (*). When the result is closer to the test limit than the accuracy of the field tester. The field tester manufacturer must provide documentation as an aid to interpret results marked with asterisks. To which extent “*” results shall determine approval or disapproval of the element under test shall be defined in the relevant detail specification, or agreed on as a part of a contractual specification.

3.2 CERTIFYING COPPER CABLE

- A. Category 6
 - 1. All tests should be in accordance with the field test specifications defined in ANSI/TIA/EIA-568-B.2-1. “Addendum 1 – Transmission Performance Specifications for 4-pair 100 Ω Category 6 Cabling.” This document will be referred to as the “Category 6 Standard.”
 - 2. The test parameters are defined in the Category 6 Standard. The test of each link shall contain all of the following parameters as detailed below. In order to pass the test, all measurements (at each frequency in the range from 1 MHz through 250 MHz) must meet or exceed the limit value determined in the above-mentioned standard.

3.3 ACCEPTANCE OF COPPER TEST RESULTS

- A. One hundred percent of the installed cabling links must pass the requirements of the applicable standards. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the final test results documentation, which shall be reviewed, approved and signed by the Contractors RCDD.
- B. Acceptance of the test results shall be given in writing after the project is fully completed and tested in accordance with Contract Documents and to the satisfaction of the Owner.

3.4 ADMINISTRATION

- A. Test results documentation
 - 1. Test results saved within the field-test instrument shall be transferred into a FLW file so it can be uploaded to Fluke Networks LinkWare software that allows for the maintenance, inspection and archiving of the test records. These test records shall be uploaded to the PC unaltered, i.e., “as saved in the field-test instrument.”
 - 2. The test results documentation shall be available for inspection by the Owner or the Owner’s representative during the installation period and shall be passed to the Owner’s representative within five (5) working days of completion of tests on cabling served by a telecommunications room or of backbone cabling. The installer shall retain a copy to aid preparation of as-built information.

3. The database for the complete project shall be stored and delivered on CD-ROM prior to Owner acceptance of the building. This CD-ROM shall include the software tools required to view, inspect, and print any selection of the test reports.
4. Circuit IDs reported by the test instrument should match the specified label ID.
5. The detailed test results documentation data is to be provided in an electronic database for each tested copper cable and shall contain the following information.
 - a. The identification of the customer site as specified by the Owner.
 - b. The name of the test limit selected to execute the stored test results.
 - c. The name of the personnel performing the test.
 - d. The date and time the test results were saved in the memory of the tester.
 - e. The manufacturer, model and serial number of the field-test instrument.
 - f. The version of the test software and the version of the test limit database held within the test instrument.
 - g. The copper identification number.
 - h. The length for each copper cable.
 - i. The overall Pass/Fail evaluation of the copper link-under-test.

END OF SECTION

SECTION 27 1100 – COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the required remote control and signal cabling indicated by the Contract Documents with supplementary items necessary for proper installation.

1.2 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references.
- C. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- D. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them. See Sections 270513.

1.3 SUBMITTALS

- A. See Section 270513.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Installation Supervision: Installation will be under the direct supervision of a Registered Technician who will be present at all times when Work of this Section is performed at Project site.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- D. Grounding: Comply with ANSI-J-STD-607-A.
- E. Hole spacing and mechanical dimensions: Comply with EIA-310.

1.5 TELECOMMUNICATION ROOMS

- A. The Telecommunications Room is generally considered to be a floor serving facility. The horizontal cross-connect links the horizontal subsystem and the backbone subsystem together.
- B. L-shaped or other shaped dimensions are not acceptable.

- C. Concrete columns in this area are not acceptable.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 GENERAL

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.
- C. Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weather tight, wet work in spaces is complete and dry, and work above ceilings is complete.

3.2 CABLE TRAYS

- A. Ladder Racks: Inside the Equipment room and Telecommunications rooms, ladder rack is to be used for horizontal wire management. This tray is designated for cabling to remain within these rooms. Any implementation of this ladder rack equipment will include spill brackets at all inside corners.
- B. Cable Tray
 - 1. The cable tray will be installed parallel to the furred out wall 6 to 12 inches inside the Telecommunications/Equipment rooms. The cable tray will continue into far enough to deliver the riser, station, horizontal, and fiber to the end destination. Cascade transitions (waterfalls) shall be used if height variations occur between the cable tray equipment and the ladder rack equipment.
 - 2. All cable trays inside the Telecommunications/Equipment rooms must be a prefabricated structure consisting of two (2) side rails connected by individual transverse members. Wire mesh type or Mono Mount wire cable tray systems will not be used. The horizontal cable tray system shall be able to support a minimum of 100 lbs of cable per linear foot.
- C. Drop-off support for the copper cable going into the frames/racks shall be used.

3.3 OUTLET BOXES

- A. Outlet boxes shall be assembled as follows
 - 1. Depth: 3.26 inches

2. Height: 4.16 inches
3. Width: 3.51 inches

3.4 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated (both sides), $\frac{3}{4}$ by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels specified in Division 06.
- B. Plywood should be installed 1 foot above finished floor.

3.5 EQUIPMENT CABINETS – WALL MOUNTED

- A. Wall-mounted equipment cabinet shall be double hinged to allow access to the back of equipment and shall have rails to mount equipment 19-inches wide. Rails shall be drilled and tapped 10-32 with universal holes spacing per EIA Standards. Cabinet shall have top and bottom knockouts for conduit entry, vented sides and be constructed of 16-gauge steel painted black with a powdered coated finish. The cabinet shall have a lockable access door with a tinted safety glass window and shall open from either the left or right side by depressing spring loaded hinges. Cabinet shall have not less than 40% available space for use by owner at completion of cable installation.
- B. 19" power strip – horizontal 20 AMP, 120v AC with twelve (12) outlets and 15' long power cord. Uses (1) rack unit.

3.6 CABLE MANAGEMENT – VERTICAL AND HORIZONTAL

- A. Horizontal cable managers shall be capable of front and rear cable management, and have capacity for cables in front of rack area. They shall be designed to be installed on a standard EIA 19" x 7' telecommunications rack. Horizontal cable managers shall have front door.
- B. Equipment cabinets - Cabinets shall be equipped with vertical and horizontal cable management hardware, in either guides or form of rings, to assist in neatly routing of copper jumpers and/or optical fiber from the 110-type termination blocks or modular patch panel to the owner provided network electronics. Horizontal cable management shall be 3.5 inches in height with minimum of five (5) jumper distribution rings.

3.7 DEMARCATION REQUIREMENTS

- A. Contractor shall coordinate with owner's selected service provider all requirements for the demarcation point.
- B. In the event that the service provider's requirements differ from the work shown on the documents, the contractor shall not proceed on the installation without a document from the engineer.

3.8 COMMUNICATION SYSTEM GROUNDING

- A. Refer to Specification Section 260526.

3.9 TELECOMMUNICATIONS ROOM

- A. Cabinets shall be placed in a manner that will allow a minimum of three (3) feet of clearance from the front and rear mounting surfaces and on one side on racks. If one mounting rail of the rack is placed against a wall, the mounting rail shall be no closer than 6" to the wall to allow room for vertical management. Where there is more than one (1) rack, the racks shall be ganged with vertical management hardware. Ganged rack frames will be placed in a manner that will allow a minimum of three (3) feet of clearance from the front and rear mounting surfaces and on one side of the ganged assembly. Open frame equipment racks shall be bolted to the floor by means of the manufacturer's recommended fasteners. Cable guides shall be bolted or screwed to racks. Racks shall be installed level. Ganged racks shall be bolted together. Ganged rack cabinets shall have adjacent side panels removed.
- B. \System components and appurtenances shall be installed in accordance with NFPA 70, manufacturer's instructions and as shown. Necessary interconnections, services, and adjustments required for a complete and operable signal distribution system shall be provided. Components shall be labeled in accordance with TIA/EIA 606. Penetrations in fire-rated construction shall be firestopped. Conduits, outlets and raceways shall be installed in accordance with Division 26. Wiring shall be installed in accordance with EIA/TIA 569A. Wiring, and terminal blocks and outlets shall be marked in accordance with TIA/EIA 606. Cables shall not be installed in the same cable tray, utility pole compartment, or floor trench compartment with ac power cables. Cables not installed in conduit or wireways shall be properly secured and neat in appearance and, if installed in plenums or other spaces used for environmental air, shall comply with NFPA 70 requirements for this type of installation.

END OF SECTION

SECTION 27 1500 – COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SCOPE

- A. Perform all Work required to provide and install the required remote control and signal cabling indicated by the Contract Documents with supplementary items necessary for proper installation.

1.2 REFERENCES

- A. See Section 270513.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- C. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.
- D. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- E. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1.3 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the Telecommunication Room or Equipment Room.
 - 1. Horizontal cabling shall contain no transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
 - 2. Bridged taps and splices shall not be installed in the horizontal cabling.
- B. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet in the horizontal cross-connect.
- C. Color and cable type designations UTP cable:
 - 1. Data and Voice: UTP CAT6, Blue
 - 2. WAPs and Kronos Clocks: UTP CAT6, Orange

PART 2 - PRODUCTS

2.1 MANUFACTURER HORIZONTAL CABLING

- A. Manufacturers: Subject to compliance with requirements, provide telecommunication systems of one (1) of the following: System warranty shall be written through the connectivity manufacturer.

CAT 6 - END TO END SOLUTIONS

1. Panduit TX 6000 Enhanced System
2. Commscope Systimax Gigaspeed 71 Series System
3. Belden-Belden

2.2 UTP CABLE

- A. Horizontal UTP Cable. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Conductors shall be four (4)-pair solid untinned copper 23 AWG. Cable shall be plenum rated CMP per NFPA 70.

2.3 UTP CABLE HARDWARE

- A. Data Outlets. Wall outlet plates shall include modular eight (8)-position jacks, quantity as indicated on the Drawings. Modular jacks shall be non-keyed eight (8)-position jacks and the color orange. A color-coded bezel or icon may be used to identify the modular jack. Modular jack pin/pair configuration shall be T568B. (Verify pin/pair configuration with Owner prior to installation.) Modular jacks shall be unkeyed. Faceplates shall be labeled face plates with recessed labeling field included to accept label card and clear plastic cover. Faceplate material and finish shall match faceplates for other wiring devices in the same room or space (See Division 26 Specification Section Wiring Devices for material and finish). Blank cover plates shall be added for unused openings on face plate.
- B. In the communications rooms, horizontal voice and data cables will terminate on RJ45 Patch Panels for VoIP solution.
- C. Rack mounted patch panels shall consist of non-keyed eight (8)-position modular jacks, modular connection system with modular jacks, arranged in rows or columns on 19-inch rack mounted panels. Patch panel shall be fully populated. Jack pin/pair configuration shall be T568B. (Verify pin/pair configuration with Owner prior to installation.) Jacks shall be unkeyed. Panels shall be provided with labeling space. Patch panels shall be 48 port. Modular patch panels shall incorporate cable support and or strain relief mechanisms to secure the horizontal cables at the termination block and to ensure that all manufacturers minimum bend radius specifications are adhered to. Provide quantity of patch panels required to accommodate the installed cable plant plus 20% spares.
- D. Copper Patch Cords: Factory-made, 18 AWG four (4)-pair RJ-45 connectors on end of cables. These cables shall be used to cross-connect between the network electronics and the horizontal RJ-45 modular patch panel. Provide 100% for all assigned ports on the modular patch panel. Of these cords, provide 40% at 7' and 60% at 10' lengths; terminated with eight (8)-position modular RJ-45 connector at each end. Patch cords shall not be made-up in the field.

1. Patch cord shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
 2. Patch cords shall have color-coded boots for circuit identification.
 3. Color and quantity: Color yellow for data and color blue for voice, one (1) for each modular jack in faceplate for project plus 20% spare.
 4. Contractor to coordinate based on room layout and with Owner prior to ordering/installing patch cords.
- E. Work Area Patch Cords: Factory-made, 18 AWG four (4)-pair cables in 10' lengths; terminated with eight (8)-position modular RJ-45 connector at each end. Patch cords shall not be made-up in the field.
1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
 2. Patch cords shall have color-coded boots for circuit identification.
 3. Contractor to provide patch cords based on the total quantity of modular patch panel ports.
 4. Color and quantity: Gray color, one (1) for each modular jack in faceplate for project plus 20% spares.
 5. Contractor to coordinate specific patchcord requirements with owner prior to ordering and installing patch cords.

2.4 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. Cables shall be terminated with connecting hardware of same category or higher.

PART 3 - EXECUTION

3.1 GENERAL

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.
- C. Cables and conductors shall sweep into termination areas; cables and conductors shall not bend at right angles. Manufacturer's minimum bending radius shall not be exceeded. When there are multiple system type drops to individual workstations, relative position for each system shall be maintained on each system termination block or patch panel.

- D. Provide service loops above the ceilings at the workstation location and in the telecommunication closet. At the workstation provide a minimum cable slack of 12-inches for UTP, cables and 40-inches for optical fiber cables. In the telecommunication closets provide a minimum cable slack of 10-feet for both UTP and optical fiber cables. Cable slack shall be neatly installed and supported by ladder rack and ladder rack drop outs above the vertical wire managers in the equipment racks.
- E. Unshielded Twisted Pair Cable: Each pair shall be terminated on appropriate outlets, terminal blocks or patch panels. Pairs shall remain twisted together to within the proper distance from the termination. Conductors shall not be damaged when removing insulation. Wire insulation shall not be damaged when removing outer jacket. The pulling tension on a four (4)-pair UTP cables shall not exceed 25 lbs. for a single or bundle of cables.

3.2 COORDINATION

- A. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area with General Contractor/Owner. The telecommunications outlet/connector shall be in close proximity to the power receptacles in each work area.

3.3 INSTALLATION OF CABLES

- A. General Requirements for Cabling
 - 1. Horizontal Distribution Cable. All cables shall be installed in a continuous raceway from each data outlet box to accessible space above ceiling, nearest cable tray, or bottom of the exposed structural joist. Outlet box shall be 4"x 4" x 2-1/8" deep box with single gang plaster ring. Provide a continuous raceway to telecommunication closet in areas without accessible ceilings. Conduit size shall be 1-inch minimum. Horizontal cabling installed in/out of cable tray shall be bundled at not less than 4' intervals with hook and loop tie wraps. The use of plastic cable ties is strictly prohibited. Provide insulated bushing at each end of conduit prior to installation of cable. The rated cable pulling tension shall not be exceeded. Cable shall not be stressed such that twisting, stretching or kinking occurs. Cable shall not be spliced. Copper cable not in a wire raceway, shall be suspended a minimum of 8-inches above ceilings by cable supports no greater than 48-inches apart. Cable shall not be run through structural members or in contact with pipes, ducts or other potentially damaging items. Placement of cable parallel to power conductors shall be avoided, if possible; a minimum separation of 12-inches shall be maintained when such placement cannot be avoided. Cables shall be terminated; no cable shall contain unterminated elements. Minimum bending radius shall not be exceeded during installation or once installed. Service loops shall have a 3 feet per cable located at the ceiling at the last support (ex. J-hook, etc.) before entering cable into conduit, wall, and surface raceway. Service loops for modular furniture/movable walls shall have an additional fifteen (15) feet per cable for horizontal cable runs of under 250 feet in length for future office layout change without recabling. Horizontal cabling fed from poke-thru device to furniture raceway shall be managed in flexible spiral wrap and neatly concealed to furniture raceway.
 - 2. Cold-Weather Installation: Follow manufacturer specifications for installation and storage temperatures. Heat lamps shall not be used for heating.

END OF SECTION

SECTION 27 4133 - TELEVISION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. These specifications include the furnishing of all labor and materials necessary for the installation of complete and operating system.

PART 2 - PRODUCTS

2.1 EQUIPMENT FURNISHED

- A. All trunk cable shall be plenum-rated, 100% dual shielded, 14 gauge, RG-11 cable listed for CATV use. Approved Manufacturers: Commscope 2287 K Plenum.
- B. All branch antenna cable shall be plenum rated, 100% dual shielded, 18-gauge, RG-6 cable listed for CATV use. Approved Manufacturer: Commscope 2227V Plenum.
- C. Owner shall be responsible to coordinate with TV service provider.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. This installation must be done in accordance with the requirements of the cable TV service provider and the general specifications herewith. Contractor shall verify all material and installation requirements prior to submitting Shop Drawings.
- B. Provide service conduit per Cable TV providers requirements and/or as shown on drawings.
- C. Provide raceway to telecommunication closet with hook and loop tie wraps. The use of plastic cable ties is strictly prohibited. Cable shall not be stressed or twisted. Cable shall be supported a minimum of 6" above ceiling by supports and no greater than 48 inches apart. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

END OF SECTION