Project Manual

Arriba Flagler Consolidated School District 20

Flagler School

MEP Renovations

100% Construction Documents

March 25, 2013

Prepared By:

Leffingwell
Consulting
Engineers, Inc.

1315 North El Paso Street
Colorado Springs, CO 80903
T: (719) 473-5998

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Project Directory

Arriba Flagler Consolidated School District 20
Flagler School MEP Renovation
Flagler, Colorado 80815

Arriba Flagler Consolidated School District 20 — Owner
421 Julian Avenue
Flagler, Colorado 80815
(719) 765-4684
Contact: Tom Arensdorf
Email: tarensdorf@af20.net

Leffingwell Consulting Engineers, Inc. — Owner's Representative/ Mechanical Engineer
1315 North El Paso Street
Colorado Springs, Colorado 80903
(719) 473-5998
Contact: Gary Leffingwell, P.E.
Email: Garyl@leffingwellce.com

Red Rock Consulting Engineers — Electrical Engineer
144 Palisade Circle
Manitou Springs, Colorado 80829
(719) 685-1266
Contact: Jeff Tanner, P.E.
Email: jtanner@redrockce.com

Bret Johnson Architecture — Architect
2304 Yosemite Street
Denver, Colorado 80238
(720) 341-0392
Contact: Bret Johnson, A.I.A.
Email: bret@bretjohnsonarchitecture.com

Anthem LLC — Structural Engineer
5171 El Dorado Springs Drive Suite M
Boulder, Colorado 80303
(303) 848-8497 Ext 1
Contact: Dan Knapp, P.E.
Email: dknapp@anthemstructural.com

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PROCUREMENT REQUIREMENTS

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REQUEST FOR PROPOSALS

Notice is hereby given that sealed proposals will be received at the Arriba Flagler Consolidated School District 20 (AFCSD20) Main Office, 421 Julian Avenue, Flagler Colorado 80815 until April 12 2013, 2:00pm local time, for the furnishing all labor, materials and equipment, and performing all work necessary and incidental to:

Flagler School MEP Renovations

in accordance with the Drawings, Specifications, and Contract Documents.

Proposals shall be delivered and addressed to the Main Office Arriba Flagler Consolidated School District 20, 421 Julian Avenue, Flagler Colorado 80815 and shall be labeled "Flagler School MEP Renovation". Any Proposer who wishes his proposal to be considered is responsible for making certain that the Main Office receives his proposal by the proper time. No oral, telegraphic, electronic, facsimile, or telephonic proposals or modifications will be considered unless specified. Proposals received after the scheduled Submittal Deadline will be returned unopened.

It is the responsibility of the Proposer to see that any Proposal submitted shall have sufficient time to be received by the Main Office before the Submittal Deadline. Late proposals will be returned to the Proposer unopened. **Proposals will not be opened publicly**.

The receiving time in the Main Office will be the governing time for acceptability of proposals. Proposals will not be accepted by telephone or facsimile machine. Proposals must bear original signatures and figures.

Proposing Documents, including Drawings and Project Manuals for proposing purposes, may be obtained from online at the following link: http://flaglerschools.co.afs.schoolinsites.com/

A mandatory pre-proposal walk-through and conference to familiarize Proposers with the scope of the Work and provide for questions and clarifications will take place at the Project site, 421 Julian Avenue, Flagler Colorado 80815, at 10:00am, April 1, 2013.

Proposal Security Bond. Each proposal shall be accompanied by a certified check, cashier's check, or bond duly completed on the form provided herewith by a guaranty company authorized to carry on business in the State of Colorado, in an amount equal to at least ten percent (10%) of the sum of the total amount proposed, including any options. Said bond is payable without condition to the Arriba Flagler Consolidated School District 20 as a guaranty that the Proposer, if awarded the contract, will promptly execute the contract in accordance with and in the manner and form required by these contract documents, will furnish the required performance bond, payment bond, and evidences of insurance, and enter into, execute, and deliver to the Main Office the agreement on the form provided herewith, within ten (10) days after being notified in writing by the Main Office that the award has been made and the agreement is ready for execution. The Proposal Security shall be forfeited to the Arriba Flagler Consolidated School District 20 as liquidated damages if Proposer fails or neglect to furnish, execute, and deliver the contract in accordance with the specifications.

Payment Bond. Upon execution of the contract, the Successful Proposer will be required to furnish a Payment Bond in an amount equal to one hundred percent (100%) of the total amount of the contract.

Performance Bond. Upon execution of the contract, the Successful Proposer will be required to furnish a Performance Bond in an amount equal to one hundred percent (100%) of the total amount of the contract. Each bid shall be accompanied with the bid by a certified check drawn on a solvent bank in the State of Colorado, or Proposal Security Bond, in an amount not less than five percent of the bid, and shall enter into a contract to build the improvements in accordance with this notice and give bond in the sum hereinafter provided for construction of the improvements. Checks and bonds accompanying Proposals not accepted shall be returned to the Proposer.

Substitution of Securities. The Contractor shall be permitted to substitute securities for any monies withheld by the Arriba Flagler Consolidated School District 20 to ensure performance under this contract, such substitution to be subject to the limitations and requirements of state law.

No Proposals shall be withdrawn after the opening of Proposals without the consent of the authorized official of the Arriba

Flagler Consolidated School District 20 for a period of 60 days after the scheduled time of opening Proposals.

The Owner reserves the right to reject any and all Proposals and to waive any technicalities in proposing.

END OF REQUEST FOR PROPOSALS

DOCUMENT 00 21 16

INSTRUCTIONS TO PROPOSERS

1. ONE PRIME CONTRACT

The work shall be executed under one prime contract covering all work in connection with general work, mechanical work and electrical work.

2. CONDITIONS AFFECTING THE WORK

The proposed Contract Documents contain the provisions required for the construction of the Project. Information obtained from an officer, agent, or employee of the Owner or any other person shall not affect the risks or obligations assumed by the contractor or relieve him from fulfilling any of the Conditions of the Contract.

Each Proposer shall make careful examination of Drawings and Project Manual, visit site of proposed construction, and fully investigate all conditions and limitations affecting work and include in its bid cost of all such items. Proposer will be held responsible for any errors in its bid resulting from failure to make such an examination.

3. STATE AND LOCAL LAWS

The Proposer’s attention is directed to the fact that all applicable federal and state laws, municipal ordinances, and the rules and regulations of all authorities having jurisdiction over construction of the Project shall apply to the contract throughout, and they will be deemed to be included in the contract the same as though therein written out in full. In particular, Proposers are expected to

familiarize themselves with the laws and acts of the State of Colorado and the ordinances of Lincoln County and the Arriba Flagler Consolidated School District 20.

Proposers shall comply with Fair Labor Standards as defined in Section 73-104-R.S., Colorado Statutes, in pursuit of all business related to this Project, including execution of the contract on this work for which Proposals are being submitted.

4. TIME OF COMPLETION

Contractor must agree to commence work within seven days following receipt of written "Notice to Proceed". Arriba Flagler Consolidated School District 20 will issue such notice within thirty days after date of opening of Proposals provided Contractor has fulfilled all requirements necessary for execution of contract. Such requirements are specified under Supplementary Conditions.

Proposer agrees to substantially complete all work within the number of calendar days Proposer fills in on its Proposal Form. Proposers must fill in number of days on Proposal Form.

5. INTERPRETATION OF DOCUMENTS

Interpretation of meaning of Drawings, Specifications or other Proposing Documents will not be made to any Proposer orally. If Proposer is in doubt as to meaning of any part of Contract Documents, or should Proposer discover discrepancies or conflicts herein, Proposer shall submit in writing to Owner's Representative request for interpretation. In event that Proposer fails to notify Owner's Representative of any discrepancies, Proposer is deemed to have estimated most expensive way of doing work.

Only interpretations made in conformity with following procedure will be valid. Interpretations either written or oral by any of Owner's Representative's consultants will not be valid.

Every request for such interpretation should be in writing addressed to Leffingwell Consulting Engineers Inc.,1315 North El Paso Street, Colorado Springs, Colorado 80903, and to be given consideration must be received by 12:00 Noon, at least ten (10) calendar days prior to date set for opening of Proposals.

Any interpretations and supplemental instructions will be in form of written addenda which, if issued, will be mailed to respective addresses furnished for such purposes, not later than three days prior to date fixed for opening

of Proposals. Failure of any Proposer to receive such addenda or interpretation shall not relieve Proposer from any obligation under its bid as submitted. All addenda so issued shall become part of Contract Documents and shall be covered in Proposals. All Proposers shall verify that they have considered all addenda.

6. CONSULTANTS

As matter of identification, names of consultants employed by Owner's Representative for various phases of work are listed on Drawings. Proposers or material suppliers shall not communicate directly with any of the consultants without permission of Owner's Representative. All questions and requests for decisions and interpretations shall be directed to Owner's Representative, who if Owner's Representative deems it advisable, will confer with its consultants regarding same. See Article 5 regarding Interpretations of Documents.

7. PARTIAL - INFORMATION

At request of parties interested in submitting sub-Proposals on portions of work, Owner's Representative may from time to time issue portions of Drawings and Specifications as convenience to said parties. Owner's Representative and Owner disclaim any and all responsibility for errors or omissions made by parties using such partial information in compiling their Proposals.

8. PROPOSALS

General Contractors on Proposal Form included in this Project Manual shall submit proposals. Forms shall not be removed from Project Manuals. Copies may be made or loose forms for proposing purposes are available from Owner's Representative upon request.

Each Proposal Form and Proposal Security must be submitted in black ink or typewritten in a sealed envelope with the following information on the outside: the Proposer's name, address, name of the Project, and the words "PROPOSAL AND PROPOSAL SECURITY: If the Proposal Form and Proposal Security is mailed, the PROPOSAL envelope shall be placed in the mailing envelope, sealed, and addressed to the Owner. The mailing envelope must have the following information on the outside: the Proposer's name, address, name of the project, and the words "PROPOSAL FORM AND PROPOSAL SECURITY". Faxed Proposals will not be accepted.

Any Proposal improperly completed or modified in any respect will be subject to rejection. Each Proposal shall specify price written with ink or typewritten in both words and figures of each of separate items as required. In case of discrepancy between written words and figures, written words shall govern.

Each Proposer is required to state in his Proposal his name and place of residence and the names of all persons interested with him. If party proposing is incorporated body, bid shall be signed by President and Secretary or duly authorized agent and be accompanied by corporate seal. If not corporation, all interested Proposers must sign proposal.

9. PROPOSAL SECURITY

Each proposal must be accompanied by a satisfactory Proposal Security Bond furnished by a solvent surety company authorized to do business in the State of Colorado payable without condition to the Arriba Flagler Consolidated School District 20 for five percent of the total amount of the proposal. As soon as the proposal prices have been compared, the Owner the bonds of the unsuccessful Proposers will be returned. The Proposal Security Bond of the successful Proposer will be retained until the Payment Bond and Performance Bond has been executed and approved, after which it will be returned. A certified check drawn on a solvent bank in the State of Colorado may be used in lieu of a Proposal Security Bond.

Proposal Security shall guarantee that proposal will not be withdrawn or modified after time limit set for receipt of Proposals and, if accepted, that person, firm, or corporation submitting same shall, within seven days after being notified of acceptance of its proposal, execute contract and shall within same time furnish required bonds and approved sureties and all insurance certificates called for by these documents.

The Party to whom the contract is awarded will be required to execute the Agreement and obtain the Performance Bond and Payment Bond within 10 calendar days from the date when Notice of Award is delivered to the Proposer. In case of failure of the Proposer to execute the Agreement, the Owner may at it's option, consider the Proposer in

default, in which case its certified check or Proposal Security Bond accompanying the Proposal shall become the property of the Owner as liquidated damages for delay and extra work entailed thereby.

10. PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND

Each Proposer shall include in its proposal a sum sufficient to cover cost of providing 100 percent

Performance Bond and Labor and Material Payment Bond as specified under Supplementary Conditions.

11. SALES AND USE TAXES

Arriba Flagler Consolidated School District 20 is a tax-exempt institution. Proposers shall follow all requirements of applicable statutes with regard to sale and use taxes and tax-exempt certificates. See Supplementary Conditions.

12. LIST OF SUBCONTRACTORS

Each Proposer shall indicate on its Proposal Form in space provided for same names of subcontractors Proposer intends to employ for listed work in event its proposal is accepted.

Following opening of Proposals and prior to award of contract, Proposer shall submit within three days, full and complete list of all subcontractors Proposer intends to employ on work in event its proposal is accepted.

When said list is accepted and contract is awarded, list shall not be changed except upon written acceptance from Owner's Representative.

13. TELEGRAPHIC MODIFICATION

Any Proposer may modify its proposal by telegraphic communication at any time prior to scheduled

closing time for receipt of Proposals, provided such telegraphic communication is received by Owner prior to closing time and provided further, Owner is satisfied that written confirmation of telegraphic modification over signature of Proposer was mailed prior to closing time. Telegraphic communication shall not reveal proposal price, but should provide addition or subtraction or other modification so that Owner will not know final prices or terms until sealed proposal is opened. If written conformation is not received within two days from closing time, no consideration will be given to telegraphic modification.

14. PROPOSER QUALIFICATION

Owner may make such investigations as it deems necessary to determine ability of Proposers to perform work, and Proposers shall furnish Owner all such information and data for this purpose as Owner may request. Any Proposer in submitting proposal represents that it has financial ability and experience to carry work through its several stages, and unless Proposer can show evidence of such ability, it will not be eligible to bid. The Owner reserves the right to reject any proposal if the evidence submitted by or investigation of, such Proposer fails to satisfy the Owner that such Proposer is properly qualified to carry out the obligations of the contract and to complete the work contemplated therein. Conditional Proposals will not be accepted.

Proposer shall provide a 5 page (maximum) qualification submittal with the bid. The submittal shall contain company information (Name, address, telephone number, years in business and Owner legal names), relevant projects and references. Relevant projects shall contain descriptions of 3 (minimum) projects of similar size and scope that have been completed within the past 5 years. Similar size and scope requirements mean an educational facility with a major mechanical remodel using packaged roof top units and new sheetmetal ductwork and a new electrical service with project square footage of about 55,000 square feet. Owner contact information (Name and telephone number) shall be provided for each listed project. Qualification submittals are required for the General Contractor, Mechanical Contractor and Electrical Contractor.

15. DISQUALIFIED PROPOSERS

Proposals will not be accepted, nor contract awarded, to any person who is in arrears to Owner upon debt or contract, or who is defaulter as surety or otherwise upon any obligation to Owner.

16. WITHDRAWAL OF PROPOSALS

Proposals that have been submitted may be withdrawn by any Proposer who desires to do so, without prejudice to himself, at any time prior to time set for opening Proposals.

Errors In Proposal – In the event of any error(s) in the extension of the individual unit bid price for any bid item to the total proposal price for that individual proposal item, the unit bid price will take precedence over the total proposal price, and the proposal will be corrected accordingly.

In addition, any totaling errors in arriving at the total proposal price will also be corrected, based on the unit prices, lump sum prices, or combination thereof. Contractors shall note that unit prices shall always prevail in computing totals for sections, divisions, and grand totals.

17. METHOD OF AWARD

The Owner may hold the Proposals for 60 days after the actual date of the opening and may award the contract at any time during that period. Should there be reasons why the contract cannot be awarded within the specified period, the time may be extended by mutual agreement between the Owner and the Proposer.

The Owner may waive any and informalities or reject any or all Proposals.

If Proposals exceed funds available, Owner may reject all Proposals or may enter into negotiation with selected Proposer(s). Award will include consideration for base proposal, unit prices, alternate prices and time of completion.

The Owner, within 10 days of receipt of acceptable Performance Bond, Payment Bond, and Agreement signed by the party to whom the Agreement was awarded, shall sign the Agreement and return to such party executed duplicate of the Agreement. Should the Owner not execute the Agreement within such period, the Proposer may by written notice withdraw his signed Agreement. Such notice of withdrawal shall be effective upon receipt of the notice by the Owner.

The Notice to Proceed shall be issued within 10 days of the execution of the Agreement by the Owner. Should there be reasons why the Notice to Proceed cannot be issued within such period, the time may be extended by mutual agreement between the Owner and the Contractor, if the Notice to Proceed has not been issued within the 10-day period or within the period mutually agreed upon, the Contractor may terminate the Agreement by duly executed written notice, without further liability on the part of either party.

18. PLANS FOR REFERENCE

Complete sets of Drawings and Specifications for the work and documents referenced in Document 00 30 00 Available Information are available online at the following address: http://flaglerschools.co.afs.schoolinsites.com/

END OF INSTRUCTIONS TO PROPOSERS

DOCUMENT 00 26 00

PROCUREMENT SUBSTITUTION PROCEDURES

1. SUMMARY

This document specifies procedural requirements for substitution requests and approvals that are applicable beginning on the date on which the Drawings, Project Manual and other Bid Documents are issued for bid, and ending six (6) calendar days prior to date set for opening of Proposals.

Limitations on change proposals and substitution requests made after award of contract and during the construction phase of the Project are specified in Section 01 25 00 Substitution Procedures.

2. CHANGES AND SUBSTITUTIONS

Items specified under manufacturers' names and catalog numbers are intended as basis of quality and not as closed specification unless noted otherwise.

Items other than those specifically named in Specifications or as indicated on Drawings will be considered provided request for acceptance of such items is received by Owner's Representative in writing by 12:00 Noon, at least ten (10) calendar days prior to date set for opening of Proposals, and is documented as required to make it possible to properly evaluate items proposed for use. If, in Owner's Representative's opinion, item or items proposed for use are acceptable substitute for items specified in design, quality, material and function, Owner's Representative will issue Addendum to all Proposers listing all such items accepted for use. Requests for substitution received after above time and date will not be considered prior to execution of the contract.

Proposers shall base their proposal upon use of any of items specifically named in Specifications and Drawings, or as accepted in Addendum issued by Owner's Representative.

Only one request for substitution for each product will be considered from any single general contract Proposer.

Owner's Representative will not make exhaustive attempt to determine that products proposed for substitution are equal to, or can be modified in order to be equal to specified products. If accepted by Owner's Representative, products proposed for substitution will be accepted subject to modifications by manufacturer, if necessary, to meet detailed requirements of Drawings and Specifications.

3. SUBSTITUTION REQUEST SUBMITTAL PROCEDURES

Submit two copies of each request. Submit separate request for each substitution.

Identify products by Specification section and article number. Provide manufacturer's name and address, trade name of products, and model or catalog number. List fabricators and suppliers as appropriate.

Document each request with complete data substantiating compliance of proposed substitution with requirements of Contract Documents: Attach Product Data. Give itemized comparison of proposed substitution with specified product, listing variation, and reference to Specification section and article numbers. Give quality and performance comparison between proposed substitution and specified product. List availability of maintenance services and replacement materials. State effect of substitution on construction schedule, and changes required in other work or products. Reference UL Fire Resistance Directory design number if applicable.

4. PROPOSER REPRESENTATION

By making Request for Substitution, Proposer represents it has investigated proposed product and has determined that it is equal to or superior in all respects to specified product. Proposer also agrees to provide same warranty for substitution as for specified product, that, if substitution and proposal are accepted, Contractor will coordinate installation of accepted substitute, making such changes as may be required for Work to be complete in all respects, and that Proposer waives claims for additional costs related to substitution which may later become apparent.

By making Substitution Request, Proposer represents that, if substitution and proposal are accepted, and If substituted products do not meet or exceed above requirements, whether before, during, or after incorporation into Work, Contractor shall, at no additional cost to Owner, replace substituted products with products originally specified.

END OF PROCUREMENT SUBSTITUTION PROCEDURES

DOCUMENT 00 30 00

AVAILABLE INFORMATION

1. INFORMATION FOR REFERENCE

The following data is offered solely for reference and is not to be considered a part of the Contract Documents.

The following documents will be available for examination at the locations indicated in the Instructions to Proposers. In preparing its proposal, each Proposer shall consider and evaluate data contained in the following documents as well as the Drawings and Project Manual prepared by the Owner's Representative. The data contained in the listed documents is believed to be reliable; however, the Owner's Representative does not guarantee its accuracy or completeness.

2. 1.02 EXISTING HAZARDOUS MATERIAL INFORMATION

This Project may have asbestos-containing materials and/or lead-based paint in area designated for remodeling and renovation.

END OF AVAILABLE INFORMATION

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DOCUMENT 00 42 13

PROPOSAL FORM

TO: Main Office
Arriba Flagler Consolidated School District 20
421 Julian Avenue
Flagler, Colorado 80815

DATED: _____201_

FROM: _____ (Contractor)

_____ (Address)

_____ (Address)

Having carefully examined the Request for Proposals, Instructions to Proposers, Available Information, General Conditions of the Contract, Supplementary Conditions, and the Specifications and Drawings entitled **Flagler School MEP Renovations**, as prepared by Leffingwell Consulting Engineers, Inc., as well as the premises and the conditions affecting the work, the undersigned proposes to furnish all labor and materials and do all work called for by them in strict accordance with the said documents for the following sum:

Proposals shall include sales tax and all other applicable taxes and fees on those items not exempt from sales tax. The work shall be bid complete in place. See Supplementary Conditions for town exemption status related to sales tax.

STIPULATED SUM BASE BID:

_____

_____ Dollars ($_____)

ALTERNATE PROPOSALS: State the amounts to be added to or deducted from the Base Bid amount if the described alternate Proposals are accepted. Refer to Section 01 23 00 of the Specifications for more detailed description of Alternates.

ALTERNATE NO. 1: Provide HVAC and electrical Systems for the Cafeteria. Add

_____

_____ Dollars ($_____)

ALTERNATE NO. 2: Provide HVAC and electrical Systems for the Music Room. Add

_____

_____ Dollars ($_____)

The undersigned acknowledges receipt of ADDENDA:

Addendum Number	Date of Addendum	Date Received
1		
2		
3		

The Proposer shall state its intended starting date and its intended completion date for Substantial Completion, and then obtain Final Completion 15 consecutive calendar days thereafter. Proposer further agrees to pay liquidated damages as specified in the Supplementary Conditions.

If a Notice of Award is received within thirty (30) days following date of proposal opening, the undersigned agrees to substantially complete the work on or before _____.

The undersigned agrees that the information submitted on this Proposal Form shall remain valid for thirty (30) days from the date of opening of Proposals.

If awarded a contract for this Project, undersigned agrees to employ the following subcontractors:

Mechanical _____

Electrical _____

The undersigned hereby agrees, if awarded the contract, to furnish a Performance Bond in the amount equal to 100 percent of the contract sum as security for the faithful performance of the contract (including guarantee provisions) and also a labor and materials Payment Bond in an amount not less than 100 percent of the contract sum as security for the payment of all persons performing labor on the Project under the contract, and furnishing materials in connection with this contract.

The undersigned also agrees to furnish the required bonds and insurance certificates, and to execute the contract within 10 days from and after the acceptance of this Proposal, and further agrees to begin and complete all work under the contract within the time limit set forth below.

Accompanying this Proposal Form, as a guaranty that the undersigned will execute the contract and furnish satisfactory bonds and insurance certificates, in accordance with the terms and requirements of the Contract Documents, is a Proposal Security of the type specified in the Instructions to Proposers, made payable to the Arriba Flagler Consolidated School District 20, in the amount of

$ _____

_____Dollars ($ _____)

Note: Proposal Security to equal 5 percent of Base Bid.

It is hereby agreed that, in case of failure of the undersigned either to execute the contract, or to furnish bonds or insurance certificates which are satisfactory to the Owner, within 10 days after issuance of Notice of Award, the amount of this proposal guaranty shall be forfeited to the Arriba Flagler Consolidated School District 20 as liquidated damages arising out of the failure of the undersigned to complete the above-stated. It is understood that, in case the undersigned is not awarded the work, the proposal guaranty will be returned, as provided in the Contract Documents.

If awarded the contract, our surety will be _____ of _____.

Proposers shall comply with Fair Labor Standards as defined in Section 73-104-R.S., Colorado Statutes, in pursuit of all business related to this Project, including execution of the contract on this work for which Proposals are being submitted.

By submitting a proposal, proposer hereby certifies that at the time of this certification, proposer does not knowingly employ or contract with an illegal alien; and that proposer has participated or attempted to participate in the E-verify program or the Department program, as defined in C.R.S. §§ 8-17.5-101(3.3) and 8-17.5-102(3.7), respectively, in order to confirm the employment eligibility of all employees who are newly hired for employment to perform the work under the public contract for services.

The undersigned recognizes the Owner's right to waive informalities in the proposing and to accept or reject any or all Proposals for any reason whatsoever.

NOTE: Proposers shall not add any conditions or qualifying statements to this proposal as otherwise the proposal may be declared irregular as not being responsive to the Request for Proposals.

Signed:_____

Title: _____

Printed Name: _____

S E A L

ATTEST: _____

END OF PROPOSAL FORM

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DOCUMENT 00 61 13

PERFORMANCE AND PAYMENT BOND FORM

1. FORM TO BE USED

Two (2) separate bonds are required:

Both the Performance Bond and the labor and material Payment Bond shall be written on AIA Document A3l2-201 0, "Performance and Payment Bond". Dates of bonds shall coincide with the date of the Contract between the Owner and the Contractor. Substitute forms may not be used.

END OF PERFORMANCE AND PAYMENT BOND FORM

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DOCUMENT 00 72 00

GENERAL CONDITIONS

1. FORM OF GENERAL CONDITIONS

CONSTRUCTION AGREEMENT

THIS CONSTRUCTION AGREEMENT ("Agreement"), is made and entered into this _____ day of March, 2013, by and between the Arriba-Flagler Consolidated School District No. 20 ("Owner"), having a principal place of business at 421 Julian Avenue, Flagler, Colorado 80815, and _____ ("Contractor") whose address is _____, in connection with the construction of _____ in Kit Carson County, Colorado ("Project").

In consideration of the compensation to be paid to the Contractor and of the mutual agreements herein contained, the parties agree as follows:

1.0 SCOPE OF THE WORK

1.1 Scope of Work. The Contractor shall perform all work required for the Project as described in the Contract Documents (the "Work") using its best skill and judgment pursuant to the standards of the profession for the Work. The Contractor will also furnish all tools, equipment, machinery, supplies, superintendence, insurance, transportation and other construction accessories, services and facilities specified or required to be incorporated in and form a permanent part of the completed Work. In addition, the Contractor shall provide and perform all necessary labor in a diligent, first-class and workmanlike manner and in accordance with the conditions and prices stated in the Bid Proposal and the requirements, specifications, stipulations, provisions and conditions of the Contract Documents, as defined herein. The Contractor shall further perform, execute, construct and complete all things mentioned to be done by the Contractor and all Work included in and covered by the Owner's official award of this contract to the Contractor, such award being based on the acceptance by the Owner of the Contractor's bid, or part thereof.

1.2 Interpretation. Should anything necessary for a clear understanding of the Work be omitted from the specifications and drawings, or should the requirements appear to be in conflict, the Contractor shall secure written interpretations or instructions from the Owner or Owner's Representative before proceeding with the Work affected thereby. Oral requests shall not be acknowledged by the Owner. Additional costs incurred by the Owner as a result of unnecessary requests made by the Contractor, as determined by the Owner, shall be the responsibility of the Contractor. It is understood and agreed that the Work shall be performed according to the true intent of the Contract Documents.

2.0 THE CONTRACT DOCUMENTS

The Contract Documents that comprise the entire agreement between the Owner and the Contractor consist of the following:

(a) Bid Package issued by the Owner, including but not limited to all technical specifications, instructions, construction plans, requirements, conditions, drawings, specifications, tests, and engineering data contained therein.

(b) This Agreement including all Exhibits to this Agreement.

(c) Performance Bond and Labor and Materials Payment Bond as required by the Owner.

(d) Notice of Award and Notice to Proceed.

(e) Contractor's bid.

(f) Any modification agreed to by both parties after execution of this Agreement and documented in a writing signed by both parties.

In the event of any inconsistency in the terms of the Contract Documents, the priority of interpretation shall be first, the terms and provisions of this Agreement, as may be modified by agreement of the parties, second the Bid Package, and third the Contractor's bid.

3.0 TERM AND TIME OF COMPLETION

Subject to earlier termination by the Owner as provided in Section 26.0 below, the term of this Agreement shall commence on _____, 2013, and continue through completion, which shall occur no later than _____, 20__ (the "Completion Date").

4.0 LIQUIDATED DAMAGES

The Contractor understands and agrees that final completion of the Project within the time provided is an essential feature of this Agreement and that the Owner will sustain substantial damages, the amount of which is not possible to accurately determine at the time of contracting, if the Work is not so completed. In view of this, the Contractor, therefore, agrees to proceed with due diligence, taking all precautions and making all necessary arrangements to insure the final completion of the work within the prescribed time. The Contractor further agrees that his failure to finally and fully complete the work within the time allowed shall be considered as a breach of the Agreement and entitle the Owner to collect liquidated damages in the sum of One Thousand dollars ($1,000.00) for each calendar day beyond the Completion Date set forth above and the date when the Project is finally complete.

5.0 CONTRACT PRICE

The Owner shall pay the Contractor for performance of the Work encompassed by this Agreement, and the Contractor will accept as full compensation therefor the lump sum of _____XX/100 Dollars ($_____), to be paid by progress payments in cash or its equivalent in the manner set forth below. Unless otherwise expressly stated, all Work, including but not limited to all equipment, materials, supplies, labor, bonds, insurance, transportation, tools, temporary structures, services, fuel, energy, light, water, and all other things necessary for the complete and proper execution of the Work contemplated by or reasonably implied from the Contract Documents, shall be included in the Contract Price and no claims for extra costs or change orders shall be allowed unless approved in writing in advance by the Owner.

6.0 PAYMENT

6.1 Schedule of Values. Progress payments shall be made on the valuation of the Work done. Within ten (10) days after the date of the notice of contract award but no later than prior to any request for payment will be considered, the Contractor shall submit to the Owner a complete, itemized schedule of the values of the various parts of the Work, aggregating the total sum of the Contract and separating material costs from other costs. Such schedule shall include as costs the material costs of all subcontractors under the Contractor and the costs of all materials to be taken from the Contractor's or subcontractors' own stocks of material. The schedule of values shall be submitted on forms supplied by the Owner and, if required, supported by such evidence as to its correctness as the Owner may direct. Each item on the schedule of values shall include its proper share of overhead and profit. The schedule of values shall be used for the estimates and progress payments provided for in this Agreement. Along with such schedule of values, the Contractor shall submit a schedule of estimated monthly application amounts to be submitted over the course of the Project to assist the Owner in arranging payments.

6.2 Payment Terms. Payments will be made in the full value of the Work performed and materials stored less ten percent (10%) of such value which shall be retained until the date of completion of all Work, unless otherwise agreed by the Owner, and less the aggregate of any previous payments. Upon the certified completion of fifty percent (50%) of the Work, as determined by the Owner, and if satisfactory progress is being made, in the opinion of the Owner, then no retainage shall be made from further monthly payments, subject to any retainages made by the Owner from the final payment. The Owner reserves the right to modify the payment schedule in the event the Project and deliverables are not proceeding to completion in the manner proposed such that the payments coincide with the percentage of total Work performed during any payment period. The Contractor shall provide the Division of Public School Capital Construction Assistance with a completed Federal Form W-9 upon submission of the Contractor's first request for payment.

6.3 Payments to Contractor. Partial payments shall be made as the Work progresses within thirty (30) days after the submittal of the properly prepared request for payment form submitted to and approved by the Owner. Requests for payment shall be submitted to the Owner on a regularly established monthly schedule approved by the Owner.

6.4 Materials. If payments are made on account of materials not incorporated in the Work but delivered and suitably stored at the Project site or at some other location agreed upon in writing, such payments shall be conditioned upon submission by the Contractor of bills of sale or such other procedures that will establish the Owner's interest, including applicable insurance and transportation to the Project site.

6.5 Title to Work and Materials. The Contractor warrants and guarantees that title to all Work, materials, and equipment covered by a request for payment, whether incorporated into the Project or not, shall pass to the Owner upon the receipt of such payment by the Contractor, free and clear of all liens, claims, security interests, or encumbrances; and that no Work, materials, or equipment covered by a request for payment shall have been acquired by the Contractor or by any other person performing the Work at the site or furnishing materials and equipment for the Project, subject to an agreement under which an interest therein or an encumbrance thereon is retained by the seller or otherwise imposed by the Contractor or such other person. This provision shall not be construed as relieving the Contractor from the sole responsibility for all materials and Work upon which payments have been made or the restoration of any damaged Work, or as a waiver of the right of the Owner to require the fulfillment of all the terms of the Contract.

6.6 Acceptance and Final Payment. Upon satisfactory completion and final acceptance of the Work by the Owner, payment will be made in full, including retained percentages thereon less deductions as determined by the Owner and any other retention required by the Colorado public works laws. The Owner shall not authorize final payment until all the items on the final construction punch list and commissioning punch list are complete. Upon submission of the final application for payment, the time of final settlement for the Work shall be set and shall be advertised by two (2) publications of notice of final payment, the last publication appearing at least ten (10) days prior to the time of final settlement. Final payment and settlement in full shall be made at the time of final settlement thus advertised, or as soon thereafter as practicable, in the judgment of the Owner, after resolution of claims and backcharges. Notwithstanding the foregoing, if any unpaid claim for labor, materials, supplies or equipment is filed with the Owner before payment in full of all sums due the Contractor on the final settlement date, the Owner shall withhold from the Contractor sufficient funds, if available, to ensure the payment of such claim, until the same is paid or withdrawn. Such payment or withdrawal shall be evidenced by filing with the Owner a receipt of payment in full or an order authorizing withdrawal signed by the claimant or its duly authorized agent or assignee. Such funds shall ordinarily not be withheld longer than ninety (90) days following the date fixed for final settlement with the Contractor as set forth in the published notice of final settlement, unless an action at law has been commenced within that time to enforce such unpaid claim and a notice of lis pendens has been filed with the Owner. At the expiration of the ninety- (90-) day period, the Owner shall release to the Contractor all funds that are not the subject of such action at law. Notwithstanding the provisions in this Section, in the event the Colorado statutory procedure as set forth herein is amended during the term of the Agreement, such amended procedure shall be substituted accordingly.

6.7 Payments Withheld. The Owner may withhold payment in whole or in part because of subsequently discovered evidence or subsequent inspections, for such an amount or to such extent as may be necessary in the opinion of either the Owner or the Owner's Representative to protect the Owner from loss on account of:

6.7.1 defective Work not remedied;

6.7.2 claims filed or reasonable evidence indicating probable filing of claims;

6.7.3 failure of the Contractor to make payments properly to subcontractors or for material or labor;

6.7.4 a reasonable doubt that the Contract can be completed for the balance then unpaid;

6.7.5 damage to another contractor;

6.7.6 failure of the Contractor to perform any portion of the Work in a timely manner or in compliance with any approved schedules; or

6.7.7 failure of the Contractor to submit on a timely basis any documentation required by the Contract Documents, including without limitation monthly progress reports, schedule of values, or request for approval of subcontractors.

6.8 Recordkeeping. The Contractor shall keep complete and accurate records, accounts and books with regard to all materials, equipment and labor involved in the performance of the Work in accordance with generally accepted accounting principles. The Owner and Owner's Representative shall have access to the Contractor's accounting records at all reasonable times, and the Contractor agrees to make any changes to its system of keeping these records as the Owner may reasonably request in writing. All such records shall be preserved and the Owner shall have access to them for six (6) years after final payment to the Contractor.

7.0 CONTRACTOR'S REPRESENTATIONS

7.1 The Contractor shall perform all of the Work set forth herein and shall not extend the credit or faith of the Owner to any other person or organizations.

7.2 The Contractor represents that it understands the nature, location, and scope of the Work, the character of the equipment and facilities needed preliminary to and during the performance of the Work, and the general and local conditions and all other matters that can in any way affect the Work and is not relying on any representations or promises by the Owner except as set forth in this Agreement.

7.3 The Contractor shall cooperate with other Contractors, if any, and employees of the Owner in performing the Work.

8.0 CONTRACTOR'S WARRANTIES

8.1 The Contractor warrants that the Work shall be conducted in a good and workmanlike manner and shall be suitable and fit for the purposes for which it is intended.

8.2 The Contractor warrants and represents that it has full authority under applicable law to execute and deliver this Agreement and to perform all of the obligations under this Agreement.

8.3 The Contractor represents that it shall perform the Work in a safe and diligent manner.

8.4 As further set forth in Section 25.0, the Contractor warrants all Work to be free from any defects in materials and workmanship for a period of two (2) year following final completion and acceptance by the Owner.

9.0 INDEPENDENT CONTRACTOR

Contractor shall perform all Work, using independent judgment and expertise, as an independent contractor and not as an employee of the Owner. Neither the Contractor nor any agent or employee of the Contractor shall be an agent or employee of the Owner nor shall any of them have any authority, express or implied, to bind the Owner to any agreement or incur any liability attributable to the Owner. Contractor acknowledges that it is not entitled to worker's compensation benefits and that Contractor is obligated to pay federal and state income tax on any moneys earned from the Owner pursuant to this Agreement.

10.0 PRIME CONTRACTOR AND SUBCONTRACTORS

The Contractor will assume all responsibility for the delivery, installation and quality of the Work regardless of whether or not the Contractor uses subcontractors. The Contractor shall be the sole point of contact with the Owner with regard to all matters covered by this Agreement. The Owner may initiate or maintain contact with any subcontractor if such contact becomes necessary, in the Owner's judgment, to mitigate the Owner's damage in the event the Contractor is in default or breach of any obligation of this Agreement.

11.0 GOVERNMENT REGULATIONS

Contractor shall comply with all laws, statutes, ordinances, standards, rules, and regulations of all federal, state, municipal, and special governmental authorities that are or may become applicable to any of the Work covered under this Agreement. Compliance shall also include, without limitation, applicable Owner policies and public records requirements.

12.0 CHANGE ORDERS

12.1 Change Order. The Owner may, at any time, by a written change order directed through the Owner's Representative, without notice to the sureties and without invalidating the Agreement, make changes in the drawings and/or specifications of the Contract Documents within the general scope thereof; order extra work; or make changes by altering, adding to, or deducting from the Work. If such changes cause an increase or decrease in the amount due under the Agreement, or in the time required for its performance, an equitable adjustment shall be made on the change order, and the Agreement shall be modified in writing accordingly. Any claim of the Contractor for adjustment under this Section must be asserted in writing within ten (10) days from the date of the Contractor's receipt of the notification of change. No change order or other form of order or directive by the Owner or Owner's Representative requiring additional compensable work to be performed, which causes the aggregate amount payable under the Contract Documents to exceed the amount appropriated for the original Agreement, shall be issued unless the Contractor is given written assurance by the Owner that lawful appropriations to cover the costs of the additional work have been made.

12.2 Minor Changes. In giving instructions, the Owner or Owner's Representative shall have authority to make minor changes in the Work that do not involve extra cost and that are not inconsistent with the purposes of the Project. Otherwise, except in an emergency endangering life or property, no extra work or change shall be made unless pursuant to a written order from the Owner signed or countersigned by the Owner, or a written order from the Owner or Owner's Representative stating that the Owner has authorized the extra work or change. No claim for an addition to the Agreement amount shall be valid unless ordered or authorized in the manner set forth within this Section 12.0.

12.3 Price Differential. The cost or credit resulting from a change in the Work shall be determined in one or more of the following ways:

12.3.1 By estimate, with a detailed cost breakdown as set forth in 12.3.3 hereinbelow, and acceptance in a lump sum, with a maximum combined markup to the Owner, for the Contractor and all affected subcontractors, not to exceed a total of fifteen percent (15%).

12.3.2 By unit prices named in the Agreement or subsequently agreed upon.

12.3.3 If the parties are unable to agree on one of the above methods, then the amount shall be determined by force account under the following formula:

12.3.3.1The actual cost of all direct labor performed (including foremen employed continuously on the work, but not the salary, or any part thereof, of the Contractor's superintendent) and the actual materials furnished for and used in such work, less all available cash, trade, or other discounts.

12.3.3.2Rental for the use of such items of equipment as have an individual value in excess of One Thousand Dollars ($1,000); provided, however, that the amount of such rental charge and the length of time and probable cost of the use of such equipment shall have been authorized in writing by the Owner.

12.3.3.3All proportionate sums paid for royalties, permits, and inspection fees.

12.3.3.4All proportionate premiums for Public Liability Insurance, workers' compensation, and other proper and necessary insurance, as well as all applicable payroll taxes.

12.3.3.5Either a predetermined lump sum; fixed fee; or a fee of fifteen percent (15%), which fee shall be applied to the total of 12.3.3.1, 12.3.3.2 and 12.3.3.3 only, and shall constitute full compensation to the Contractor and all its subcontractors for all costs and expenses, including all overhead and profit, which are not otherwise enumerated in this 12.3.3.

12.3.3.6The Contractor shall keep and present, in such manner as the Owner may direct, an accurate accounting of all the fees and costs described in this 12.3.3, together with all supporting vouchers and other documentation, all subject to audit by the Owner.

12.4 Construction Change Directive. A construction change directive is a written order from the Owner to the Contractor directing that a change in the Work be made and that the specified work proceed immediately or by the date otherwise directed before reaching agreement on the adjustment, if any, in the contract amount. Upon receipt of a construction change directive, the Contractor shall proceed with the change as directed and advise the Owner in writing, within ten (10) days from the date of the Contractor's receipt of the directive, whether the Contractor objects to the Owner's proposed adjustment in the contract amount or time. The Contractor's failure to respond within that time shall be considered agreement with the Owner's determination and the directive shall become an approved change order. If the Contractor files a timely written objection to the proposed price or time adjustment or the construction change directive does not include a proposed price or time adjustment and the parties are unable to reach a mutual agreement upon both within twenty (20) days after the date of the Contractor's receipt of the directive, then the cost or credit resulting from the construction change directive shall be determined in the same manner as provided in Section 12.3 above.

13.0 CLAIMS

Contractor shall pay, satisfy, and discharge all taxes, claims, charges, or other impositions of any nature or kind imposed on Contractor or the Project arising out of or in connection with the Work performed or provided hereunder and shall hold harmless and indemnify the Owner from any such claims.

14.0 LICENSING REQUIREMENTS

As a condition of this Agreement, Contractor shall maintain in effect at all times during the term of this Agreement, any necessary license and/or registration as may be required by applicable law. Contractor shall ensure that each of its employees, subcontractors, or similar personnel that is subject to licensing and/or registration maintains in effect at all times while performing work on the Project, a valid and appropriate license and/or registration.

15.0 TAXES

The Owner is exempt from paying any State sales or use taxes on any materials, supplies, or other equipment used or installed in the Work. To effectuate this exemption, the Contractor shall obtain a Certificate of Exemption from the Colorado Department of Revenue and file copies with the Owner before making any purchases or commencing work. No amounts paid to the Contractor pursuant to this agreement shall include reimbursement for such taxes.

16.0 INSURANCE OF CONTRACTOR

The Contractor shall purchase and maintain in effect at all times during the term of the Agreement the policies of insurance described below. All such insurance shall be subject to the Owner's approval for adequacy of protection, and shall include a provision preventing cancellation without thirty (30) days' prior written notice to the Owner. The certificate of insurance will indicate any limitation of coverage in the Contractor's insurance policy such as claims made, defense within limits and aggregates, etc. Acceptance of a certificate with less than the required amounts and coverage shall not be deemed a waiver of those requirements. Notwithstanding the preceding, the Owner may waive or modify the requirements of this Section 16. Such waiver or modification shall not be effective unless made in writing executed by an appropriate officer or employee of the Owner.

16.1 Liability Insurance Requirements. The Contractor shall procure and maintain, at its own expense and until the Owner's final completion and acceptance of the Work and including the one-year warranty period, liability insurance as hereinafter specified:

16.1.1 Contractor's General Public Liability and Property Damage Insurance issued to the Contractor and protecting it from all claims for personal injury, including death and occupational sickness and disease, and all claims for destruction of or damage to property arising out of or in connection with any operations under the Agreement, whether such operations be by the Contractor or by a subcontractor under it, or anyone directly or indirectly employed by the Contractor or by a subcontractor under it, or by anyone for whose acts any of them may be liable. All such insurance shall be written with a limit of liability of not less than $1,000,000 for all damages arising out of bodily injury, including death, at any time resulting therefrom, and property damage and employer's liability up to $1,000,000. All such insurance shall be written on a comprehensive policy form on an occurrence basis, and shall specifically cover all blasting operations, elevators, products, completed operations, explosions, collapse, subsidence, and underground damage. Certificates evidencing the issuance of such insurance, addressed to the Owner, shall be filed with the Owner within ten (10) days after the date of the notice of contract award.

16.1.2 The policy shall include the Owner as an additional insured. The insurer shall give the Owner at least thirty (30) days' prior written notification of any cancellation or termination of the policy, refusal to renew the policy, or any change in coverage of the policy.

16.2 Workers' Compensation Insurance. The Contractor shall maintain at its own expense, until completion of the Work and final acceptance thereof by the Owner, workers' compensation insurance, including occupational disease provisions, covering the obligations of the Contractor in accordance with the provisions of the laws of the State of Colorado, and employer's liability of not less than $100,000 per occurrence and $100,000/disease for each employee. The Contractor shall furnish the Owner with a certificate giving evidence that the Contractor is covered by the workers' compensation insurance herein required; each certificate specifically stating that such insurance includes occupational disease provisions. All such certificates shall be furnished within ten (10) days after the date of the notice of contract award.

16.3 Builder's Risk Completed Value Insurance. The Owner shall pay for and maintain Builder's Risk Completed Value Insurance, insuring property of every kind and description to be incorporated into the work, including materials and supplies, used or to be used, as part of or incidental to the construction operations under this Contract, in the amount of the initial contract sum, plus the value of subsequent contract modifications and cost of materials supplied or installed by others, comprising total value for the entire Project at the site on a replacement cost basis without optional deductibles. The insurance shall exclude the Contractor's and its subcontractors' equipment, tools, and machinery, or any other items of any description that are not incorporated into the work. Faulty workmanship shall also be excluded. The Builder's Risk Insurance shall be on an "all risk" or equivalent policy form and shall provide coverage against physical loss or damage caused by fire with "extended coverages," theft, vandalism, malicious mischief, collapse, earthquake, flood, windstorm, falsework, testing and startup, temporary buildings and debris removal including demolition occasioned by enforcement of any applicable legal requirements, and shall cover reasonable compensation for Owner's, Owner's consultant's and Contractor's services and expenses required as a result of such insured loss. The insurance shall include a minimum deductible of $5,000. The Contractor shall pay costs not covered because of such deductibles. The Builder's Risk Insurance shall remain in effect, unless otherwise provided in the Contract Documents or agreed in writing by all persons or entities who are beneficiaries of such insurance, until final payment has been made or until no person or entity other than the Owner has an insurable interest in the property or the date of final acceptance of the Project, whichever is later. This insurance shall include interests of the Owner, Contractor, and subcontractors in the Project as named insureds.

16.3.1 A loss insured under the Owner's Builder Risk Insurance shall be adjusted by the Owner and made payable to the Owner on behalf of the Contractor and its subcontractors as their interests may appear. The Contractor shall pay subcontractors their just portions of any insurance proceeds received by the Owner and paid to the Contractor.

16.3.2 The Contractor and its subcontractors and suppliers waive all rights against the Owner for damages caused by fire or other perils to the extent covered by the Builder's Risk Insurance obtained pursuant to this Section or other property insurance applicable to the Work, except such rights as they may have to the proceeds of such insurance held by the Owner on their behalf. The Contractor shall require similar waivers of its subcontractors, sub-subcontractors, agents, and employees of any of them.

16.3.3 Unless the Owner agrees otherwise in writing, all monies received shall be applied toward rebuilding or repairing the destroyed or damaged work.

16.4 Comprehensive Automobile Liability. The Contractor shall pay for and maintain Comprehensive Automobile Liability Insurance, including owned, non-owned, and hired vehicles with a combined single limit of $1,000,000/person, $1,000,000/accident, and $1,000,000/property damage. This policy shall include the Owner as an additional insured. The insurer shall give the Owner at least thirty (30) days' prior written notification of any cancellation or termination of the policy, refusal to renew the policy, or any change in coverage of the policy.

16.5 Subcontractor Insurance Requirements. If applicable, Contractor shall require all of its subcontractors to maintain Workers' Compensation Insurance, Comprehensive General Liability Insurance, and

Comprehensive Automobile Liability Insurance with the same limits and conditions as insurance maintained by Contractor herein.

16.6 Additional Miscellaneous Insurance Provisions. Certificates of insurance and/or insurance policies required under this Agreement shall be subject to the following stipulations and additional requirements:

16.6.1 Any and all deductibles or self-insured retentions contained in any insurance policy shall be assumed by and at the sole risk of the Contractor;

16.6.2 If any of the said policies shall fail at any time to meet the requirements of the Contract Documents as to form or substance, or if a company issuing any such policy shall be or at any time cease to be approved by the Division of Insurance of the State of Colorado, or be or cease to be in compliance with any stricter requirements of the Contract Documents, the Contractor shall promptly obtain a new policy, submit the same to the Owner and State of Colorado for approval if requested, and submit a certificate of insurance as hereinbefore provided. Upon failure of the Contractor to furnish, deliver and maintain such insurance as provided herein, this Agreement, in the sole discretion of the State of Colorado, may be immediately declared suspended, discontinued, or terminated. Failure of the Contractor in obtaining and/or maintaining any required insurance shall not relieve the Contractor from any liability under the Agreement, nor shall the insurance requirements be construed to conflict with the obligations of the Contractor concerning indemnification;

16.6.3 All requisite insurance shall be obtained from financially responsible insurance companies, authorized to do business in the State of Colorado and acceptable to the Owner;

16.6.4 Receipt, review or acceptance by the Owner of any insurance policies or certificates of insurance required by the Agreement shall not be construed as a waiver or relieve the Contractor from its obligation to meet the insurance requirements contained in this Agreement.

16.6.5 The parties understand and agree that the Owner does not waive or intend to waive any provision of the Agreement, including the provisions of this Section 16.0; the monetary limitations of the Agreement; or any of the rights, immunities, and protections provided by the Colorado Governmental Immunity Act, C.R.S. § 24-10-101 *et seq.*, as from time to time amended, or otherwise available to the Owner.

17.0 PERFORMANCE AND PAYMENT BONDS

17.1 Delivery of Bonds. Before commencing any work under this Agreement, the Contractor shall furnish bonds to the Owner in the full amount of the Contract Price, covering both the faithful performance of the Agreement and the payment of all obligations for labor and materials arising thereunder, on such forms as the Owner may prescribe. Such bonds must be issued by qualified sureties legally authorized to write such bonds in the State of Colorado and rated in Best's Insurance Guide (latest edition) not lower than A- and have a Best's Financial Rating of at least X and shall provide that if the Contractor or its subcontractors fail to duly pay for any labor, materials, or other supplies used or consumed by such Contractor or its subcontractors in the performance of the work contracted to be done, the surety will pay the same in an amount not exceeding the sum specified in the bond, as adjusted by approved change orders, and together with interest as provided by law. The Performance Bond shall additionally guarantee that the Contractor shall remedy any omissions; correct any and all defects; and adjust and make operable all component parts of the Work falling under the requirements of its Agreement that may be called to its attention within a period of twenty-four (24) months following the date of final completion and acceptance by Owner.

17.2 Additional Bond Requirements. The premium for all bonds shall be paid by the Contractor and included in the bid price in the bid proposal. The Owner will accept and approve bonds written by sureties legally

authorized to write such bonds in the State of Colorado, provided such surety companies are rated in Best's Insurance Guide (latest edition), not lower than A- or have Best's Financial Rating of at least X. If, at any time a surety on such a bond becomes irresponsible or loses its right to do business in the State of Colorado, the Owner may require another surety acceptable to the Owner, which the Contractor shall furnish within ten (10) days after receipt of written notice to do so.

18.0 INSPECTION OF WORK

18.1 Authority. Gary Leffingwell of Leffingwell Consulting Engineers, Inc. shall be the Owner's Representative during construction and until the expiration of the warranty period. The Owner's Representative shall have authority to act on behalf of the Owner only to the extent expressly provided in the Contract Documents or otherwise in writing. The Owner's Representative, with written approval of the Owner, shall have authority to stop the work whenever such stoppage may be reasonably necessary in its opinion to ensure the proper execution of the Agreement.

18.2 Decisions. The Owner's Representative shall be, in the first instance, the interpreter of the conditions of the Agreement and the judge of its performance, although the Owner shall retain the final authority in decisions regarding such matters. The Owner's Representative shall, within a reasonable time, make recommendations on all claims of the Contractor and on all other matters relating to the execution and progress of the Work. All such decisions shall be subject to review by the Owner. The Owner's Representative's decisions in matters relating to the installation and performance of the systems, after consultation with the Owner, shall be final, if within the terms of the Contract Documents.

18.3 Owner Inspection. The Owner reserves the right to inspect the Work at all reasonable times and places during the term of this Agreement, including the warranty period. If any of the Work does not conform to contract requirements, the Owner may require the Contractor to perform the Work again in conformity with contract requirements with no additional payment. When defects in the quality or quantity of Work cannot be corrected by re-performance, the Owner may (1) require the Contractor to take necessary action to ensure that the future performance conforms to the contract requirements and (2) equitably reduce the payment due the Contractor to reflect the reduced value of the Work performed. These remedies in no way limit the remedies available to the Owner in the termination provisions of this Agreement.

19.0 TESTING OF PROJECT BUILDING SYSTEMS

The Contractor shall submit a written plan prior to final completion and acceptance of the Project, consistent with the Contract Documents and applicable codes, for the testing of all Project building systems. All such testing shall be of complete systems, before covering, or of individually separable larger portions of the systems, and shall be performed in the presence of the appropriate consultant and Owner's Representative. A written report shall be filed with the Owner, recording each test and signed by the Owner's Representative.

20.0 TEMPORARY OR TRIAL USAGE

20.1 Not Evidence of Acceptance. Temporary or trial usage by the Owner of any mechanical device, machinery, apparatus, equipment, or any Work or material supplied under the Contract before final completion and written acceptance by the Owner shall not be construed as evidence of the Owner's acceptance of same or the commencement of any warranty period.

20.2 Authorization. The Owner has the privilege of such temporary or trial usage, for such reasonable time as the Owner deems proper. The Contractor shall make no claim for damage or injury to or breaking of any parts of such Work that may be caused by weakness or inaccuracy of structural parts or by defective material or

workmanship. If the Contractor so elects, it may, without cost to the Owner, make such trial usage. However, trials shall only be conducted with the Owner and Owner's Representative's prior approval and under the Owner's Representative's observation.

20.3 Contractor's Responsibility. When heating, air conditioning, ventilation, exhaust, or items of electrical or other equipment are installed, it shall be the responsibility of the Contractor installing such equipment to operate it for a sufficient period of time for proper testing of the equipment and instructing the Owner's operating personnel. All items of equipment, testing meters, testing instruments, and incidentals required for proper testing and for instructing the Owner's operating personnel shall be provided by the Contractor responsible for providing and installing the equipment.

21.0 OCCUPANCY

Upon the Owner's written request, the Contractor, shall allow the Owner to occupy portions of the Work and to place and install, subject to reasonable restrictions, as much equipment and furnishings during the progress of the Work as is possible without interfering with the progress of the Work. Such occupancy and the placing or installing of equipment and furnishings shall not in any way evidence the final completion of the Work or signify the Owner's acceptance of the Work, or any part of it. Equipment includes such things as kitchen equipment, etc. Furnishings include such things as lockers, benches, desks, etc.

22.0 INDEMNIFICATION

To the fullest extent permitted by law, Contractor shall indemnify and hold the Owner and its agents and employees harmless from and against all claims, actions, damages, liabilities, losses, and expenses, including attorneys' fees arising out of or resulting from the performance of the work, provided that any such claim, action, damage, liability, loss, or expense (a) is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property, including the Work itself and including the loss of use resulting therefrom, and (b) only to the extent that it is caused in whole or in part by any negligent or intentional act or omission or breach of contract of the Contractor, any subcontractor, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable. This specific indemnification by the Contractor is in addition to and not in lieu of other remedies which may be available to the Owner.

23.0 USE OF WORK PRODUCT

Contractor's Work Product, including without limitation, Contractor's notes, memoranda photographs, spreadsheets, data, designs, plans, drawings, submittals, redlines and revisions made thereto, and any other documents produced throughout the Project, shall be delivered to the Owner within the time frame(s) contemplated by this Agreement or at the latest upon the date of final completion, shall become the property of the Owner, and may be used by the Owner for any purpose connected with the Project or other Owner applications. The Contractor shall defend all suits or claims for infringement of any alleged patent rights, copyright or trade secrets arising out of Owner's ownership or use of Contractor's Work Product and shall indemnify and hold harmless the Owner from any and all liability or loss on account thereof and shall pay any judgments or fees resulting therefrom, including but not limited to, royalties, license fees, and attorneys' fees.

24.0 CORRECTION OF WORK

24.1 Correction of Work Before and After Completion. The Owner has the authority to reject work that is defective or otherwise does not conform to the Contract Documents. The Contractor, following written demand, shall promptly correct all work rejected by the Owner as defective or as otherwise failing to conform to the Contract Documents, whether observed before or after final completion and whether or not fabricated,

installed, or completed. The Contractor shall bear all costs of correcting such rejected work, including the cost of the Owner's and/or Owner's consultant's additional services necessitated thereby. If the Contractor proceeds to build in or cover the item that has been rejected, the Contractor shall be totally responsible for the cost of removal and replacement of said item and removal and replacement of all necessary work surrounding or covering the item.

24.2 Tests to Determine Conformance. As provided in the Contract Documents or whenever in the opinion of the Owner or the Owner's Representative tests are essential to assure the professional evaluation of the work that is subject to being rejected or condemned, the necessary number of tests shall be performed by consultants designated by the Owner. The recommendation of such consultants shall be final and all parties to the Agreement shall comply with the methods and extent of the corrections submitted in writing to the Owner by such consultants. The cost of the tests shall become the Contractor's responsibility when corrections of any nature are recommended by the consultant to the investigated work; otherwise, the Owner shall pay for all tests performed. Should such special testing, inspection, or approval be caused by the Contractor's failure to follow the requirements of the Contract Documents or required tests indicating conditions not in conformance with the Contract Documents, the costs of such additional testing, inspection, or approval shall be borne by the Contractor, regardless of the results.

24.3 Removal of Rejected Work. The Contractor shall promptly remove from the Project site all work rejected by the Owner as failing to conform to the Contract Documents, whether or not the work is physically incorporated. Thereafter, the Contractor shall promptly replace and re-execute such work in accordance with the Contract Documents and without expense to the Owner. The Contractor shall further bear the expense of making good all work of other contractors and/or subcontractors destroyed or damaged by such removal or replacement, and shall bear the expense of making good all of its work and the work of its subcontractors found to be defective by such removal or replacement. If the Contractor does not remove such rejected work within a reasonable time, fixed by written notice from the Owner through the Owner's Representative, the Owner may remove it and may store the material at the expense of the Contractor. If the Contractor does not pay the expenses of such removal and storage within ten (10) days' time thereafter, the Owner may, upon ten (10) days' written notice, sell such materials at auction or at private sale. In such case, the Owner shall account to the Contractor for the net proceeds thereof, after deducting all the costs and expenses that should have been borne by the Contractor, including compensation for additional design or consultant services. If the net proceeds of sale do not cover all costs that the Contractor should have borne, the difference shall be charged to the Contractor and an appropriate change order shall be issued. If the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the Owner. In addition, the Owner shall have any other remedies that may be available to it.

24.4 Correction of Work After Final Payment. Neither the final estimate or payment, nor any provision in the Contract Documents, shall relieve the Contractor of responsibility for faulty materials or workmanship and, unless otherwise specified, the Contractor shall remedy any defects due thereto and pay for any damage to other work or property resulting therefrom, which appear within a period of one (1) year from the date of final completion and acceptance. This warranty shall be in addition to and not in lieu of all other remedies available to the Owner.

24.5 Failure to Correct the Work. If the Contractor fails to correct defective or nonconforming work, the Owner may correct it and otherwise proceed against the Contractor for the cost thereof in accordance with the provisions of these General Conditions.

24.6 Deductions for Uncorrected Work. If the Owner deems it inexpedient to correct work that has been damaged, is defective or has not been done in accordance with the Contract Documents, an appropriate deduction from the Contract Price shall be made and reflected by a change order or, if the amount is determined after final payment, it shall be paid by the Contractor.

24.7 Additional Obligations. The obligations of the Contractor to correct the work shall be in addition to, and not in lieu of, any other obligations imposed upon it by law, special guarantees, warranties, or other rights of the Owner.

25.0 WARRANTIES ON PORTIONS OF THE WORK

The Contractor shall, in case of Work performed or materials or equipment provided for which warranties are required by the Contract Documents, secure the required warranties and deliver copies thereof to the Owner at the time that the Work is finally completed. All such warranties shall commence on the date set forth in the letter of acceptance and shall not in any way reduce the Contractor's responsibilities under this Agreement. Notwithstanding the foregoing, the warranty period shall not begin with respect to any item that is not completed on the date set forth in the letter of acceptance until such item is finally completed. Whenever guarantees or warranties are required by the specifications for a longer period than one year, such longer period shall govern.

26.0 TERMINATION

26.1 This Agreement may be terminated by the Owner upon not less than five (5) days' written notice should the Contractor fail substantially to perform in accordance with the terms of this Agreement through no fault of the Owner and may be terminated by the Owner upon thirty days' written notice without cause. Contractor shall not terminate this Agreement, without the written consent of the Owner, other than for nonpayment as provided below. In the event of termination of this Agreement not due to the fault of the Contractor, the Contractor shall be paid for Work performed to the date of termination, including reimbursable expenses then due. In the event of a termination for cause, the Owner may finish the Work by whatever method it may deem best and the Contractor shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price shall exceed the expense of finishing the Work, including compensation for additional managerial and administrative services, such excess shall be paid to the Contractor. If such expense shall exceed the unpaid balance, the Contractor and its surety shall pay the difference to the Owner. In the event of termination, the Contractor shall deliver to the Owner all Work Product prepared by or in the possession of the Contractor.

26.2 If the Project is suspended or abandoned by the Owner, in whole or in part, for more than two (2) months, the Contractor shall be compensated for all Work performed prior to receipt of written notice from the Owner of such suspension or abandonment, together with all reimbursable expenses then due. At its sole discretion, the Owner may terminate this Agreement by giving written notice to the Contractor if the Project is abandoned or suspended for more than two (2) months.

26.3 If the Owner fails to make any undisputed payment when due, the Contractor may, upon ten (10) days' written notice to the Owner, suspend performance of Work. Unless payment is received by the Contractor within ten (10) days of the date of the notice, the suspension shall take effect without further notice.

27.0 OWNER'S ACTIONS

Any approvals or acceptance by the Owner in relation to this Agreement shall be an approval or acceptance of concepts based on the Contractor's representations and such approval or acceptance shall not be deemed to supersede the Contractor's judgment as to the technical sufficiency or propriety of the matter.

28.0 FORCE MAJEURE

Neither the Contractor nor the Owner shall be liable to the other for any delay in, or failure of performance of, any

covenant or promise contained in this Agreement, nor shall any delay or failure constitute default or give rise to any liability for damages, if and only to the extent that, such delay or failure is caused by “force majeure.” As used in this Agreement, “force majeure” means acts of God; acts of the public enemy; acts of the Owner and any governmental entity in its sovereign or contractual capacity; fires; floods, epidemics; quarantine restrictions; strikes or other labor disputes, freight embargoes; illegality, or unusually severe weather.

29.0 LIENS

It is hereby mutually understood by and between the parties hereto that no contractor, subcontractor, materialman, vendee, laborer, mechanic, or other person, can or will contract for or in any other manner have or acquire any lien upon the project building or works covered by this Agreement, or the land upon which the same is situated.

30.0 LIMITATION OF ACTIONS

Unless a longer period is provided by law, any legal action brought by the Owner against the Contractor to recover damages for injury to person, damage to property (including without limitation loss or damage to property on the Project itself), or defects in materials or workmanship shall be brought within two years after the claim for relief arises and is discovered by the Owner; provided, however, if written notice of a potential claim is given to the Contractor within such two- (2-) year period, then an action may be brought within four (4) years after the claim for relief arises and is discovered by the Owner. "Discovered" as used herein means detection and knowledge by the Owner of the defect in the improvement or Work which ultimately causes the injury or damage (when such defect is of a substantial or significant nature) and the cause of such defect. In no case shall such an action be brought more than ten (10) years after final completion and acceptance of the Project.

31.0 FUNDS AVAILABILITY

Financial obligations of the Owner payable after the current fiscal year are contingent upon funds for that purpose being appropriated, budgeted, and otherwise made available. In the event funds are not appropriated, budgeted or otherwise made available, the Agreement shall be terminated on the last day of the period for which funds were appropriated or monies made available for such purposes.

32.0 EMPLOYEES

32.1 Qualifications. The Contractor and its subcontractors, if any, shall at all times enforce strict discipline and good order among their employees, and shall not employ any persons on the project considered by the Owner to be unfit or not skilled in the work assigned to them. The Contractor shall also keep its employees and those of its subcontractors from socializing on the Project site before and after working hours and from fraternizing at any time with staff, students, parents, and other persons who are at the school or the Project site.

32.2 Compliance with Laws and Policies. Contractor shall abide by all applicable Owner policies and procedures, including without limitation those related to the prohibited use and/or possession of alcohol, tobacco or firearms on Owner grounds. The Contractor shall at all times strictly enforce this prohibition among its own employees, agents or subcontractors and their employees, agents or subcontractors. Employees who violate these prohibitions shall be subject to disciplinary action by their employers up to and including termination, and may be denied access to the Project site. Violation of this provision shall also constitute sufficient grounds for termination of the Agreement or any subcontract, with damages or penalty to the Owner.

32.3 Equal Opportunity. During the performance of this Agreement, the Contractor shall not discriminate against any employee or applicant for employment because of race, religion, color, gender, sexual orientation, national origin, veteran status or marital status. The Contractor shall take action to ensure that applicants are employed and that employees are treated during employment without regard to their race, religion, color, gender, sexual orientation, national origin, veteran status or marital status. Such action shall include, but not be limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places available to employees and applicants for employment, notices setting forth the policies of nondiscrimination.

32.4 Responsibility for Employees. The Contractor shall be responsible to the Owner for the acts and omissions of all its agents and employees. The Contractor shall also be responsible for the acts and omissions of all its subcontractors and their agents and employees, and all other persons acting on behalf of the Contractor or subcontractors as set forth herein.

32.5 Illegal Aliens. The Contractor shall not knowingly employ or contract with an illegal alien to perform work under this Agreement, or enter into a contract with a subcontractor that fails to certify to the Contractor that the subcontractor shall not knowingly employ or contract with an illegal alien to perform work under this public contract.

32.5.1 The Contractor represents, warrants, and agrees that it has confirmed the employment eligibility of all employees who are newly hired to perform work under this Agreement through participation in either the E-Verify Program or the Colorado Department of Labor and Employment Program. Contractor shall not use the E-Verify Program or the Department Program to undertake pre-employment screening of job applicants while the Agreement is being performed.

32.5.2 If the Contractor obtains actual knowledge that a subcontractor performing work under

this Agreement knowingly employs or contracts with an illegal alien, the Contractor shall:

32.5.2.1Notify the subcontractor and the Owner within three (3) days that the Contractor has actual knowledge that the subcontractor is employing or contracting with an illegal alien; and

32.5.2.2Terminate the subcontract if within three (3) days of receiving actual notice the subcontractor does not stop employing or contracting with the illegal alien, except that the Contractor shall not terminate the subcontractor if during such three (3) days the subcontractor provides information to establish that the subcontractor has not knowingly employed or contracted with an illegal alien.

32.5.3 The Contractor shall comply with any reasonable request by the Department of Labor and Employment (hereinafter referred to as the "Department") made in the course of an investigation that the Department is undertaking pursuant to C.R.S. § 8-17.5-102(5).

32.5.4 If the Contractor violates the provisions of this Section 32.5 or C.R.S. § 8-17.5-101 *et seq.*, the Owner may terminate the Agreement for breach and the Contractor shall be liable for actual and consequential damages.

32.6 Premises Access Certification. Contractor certifies it shall not employ on the Owner's premises any persons convicted of any felony or misdemeanor crime of unlawful sexual behavior involving children.

33.0 WORK IN EXISTING BUILDINGS

33.1 Protection of Existing Facility. In addition to all other requirements of the Agreement, the Contractor shall erect and maintain during the progress of the Work, suitable dustproof or airtight partitions to protect the building and any occupants thereof. If necessary, in the Owner's or Contractor's judgment or pursuant to the Owner's Representative's, design professionals or independent consultants' directives or recommendations, in order to protect occupants or spaces from noxious fumes, odors, hazardous substances, or airborne substances, the Contractor may, at no additional cost to the Owner, be required to provide additional ventilation and/or to work different or extended hours to avoid disruption to other activities within the existing building. The scheduling of all Work shall be submitted to the Owner for approval. The various subcontractors will schedule their work jointly, in order that each may accomplish its work within such existing building in an orderly fashion during regular school vacation periods, evenings, or weekends where possible, or in such a manner as to permit full use of the building and without impairment of any existing facilities.

33.2 Contractor's Responsibilities. The Contractor shall at all times keep the Project site free from accumulations of waste material and rubbish caused by its employees or work, and shall remove all rubbish as often as it deems necessary or as directed by the Owner. Upon completion of the work, the Contractor shall remove all its rubbish, tools, scaffolding, and surplus materials from and about the Project site, and shall wash all glazing and window frames inside and outside throughout the Project building, removing all stains, paint, etc., from same. Care shall be taken not to scratch the glazing in this clean up.

33.3 Standards. All floors and wall coverings shall be left thoroughly clean and finished; all walls and ledges shall be dusted; all plumbing fixtures shall be cleaned; all hardware shall be free of all labels, paint, stains, dust, dirt, and the like; all marks, stains, fingerprints, oil, and dirt shall be removed from painted, decorated, or natural finish work and the Project building shall be ready for occupancy except for being further equipped by the Owner. In case of dispute, the Owner may perform such cleaning up as may be required and charge the cost to the Contractor.

34.0 MATERIALS, LABOR, FACILITIES, AND STORAGE

34.1 Contractor's Responsibility. Unless otherwise agreed in writing, the Contractor shall provide and pay for all materials, labor, tools, equipment, machinery, transportation, and other facilities necessary for the proper execution and completion of the Work. The Contractor shall provide and pay for all the temporary facilities required to supply all the power, light, water, and heat needed by it and its subcontractors for their Work and shall install and maintain all such facilities in such manner as to protect the public and workers and to conform with any applicable laws and regulations. If temporary heat and/or protection is required for the expeditious prosecution of the Work and before the permanent heating apparatus is available for use, the temporary heating apparatus shall be installed and operated in such a manner that the finish Work and/or construction will not be damaged thereby. Unless otherwise specified, the Contractor shall pay for all the power, light, and water used by it and its subcontractors, without regard to whether such items are metered by temporary or permanent meters. The cutoff date on permanent meters shall be either the agreed date of full occupancy by the Owner or the date of final completion of the Project, whichever shall be the earlier date. Upon completion of the Work, the Contractor shall remove all such temporary facilities from the Project site.

34.2 Materials. Unless otherwise specified, all materials shall be new and both Workmanship and materials shall be of the highest quality. The Contractor shall furnish satisfactory evidence to the Owner as to the kind and quality of materials. Samples shall be furnished, when specified, and the Work shall be in accordance with those samples that have been approved.

34.3 Toilet Facilities. The Contractor shall provide and maintain, in a neat and sanitary condition, adequate temporary toilet facilities for the use of any and all employees engaged on the Work, in strict compliance with the requirements of all applicable codes, regulations, laws, and ordinances. In no event may present toilet facilities of any existing building at the site of the Work be used by employees of the Contractor or its subcontractors. Upon final completion of the Work, the Contractor shall remove all such temporary facilities from the site and disinfect the premises.

34.4 Facilities and Storage. The Contractor shall provide suitable temporary facilities and quarters for workers, as needed, and shall maintain on premises water-tight storage sheds or tool houses for storage of building materials and tools that could be damaged by weather. The Contractor shall allow space for the erection of sheds and provide similar facilities for storage by subcontractors of their materials and tools. Storage of materials shall be confined to the site. These facilities or quarters shall further provide for protection against theft and damage of building materials and tools. Upon final completion of the Work, the Contractor shall remove all such temporary facilities from the site.

34.5 Office Space. The Contractor shall provide adequate, weatherproofed, heated and well-lighted office space at the site of the Work, for use by the Architect and the Owner and their representatives. The Contractor shall also provide telephone service at such office, which shall be available for use by the Architect, the Owner, and their representatives without charge, except for toll calls.

34.6 Quality and Location of Facilities. All of the foregoing facilities shall be of a quality and placed in locations acceptable to the Architect and the Owner.

35.0 CLEANING UP

35.1 Contractor's Responsibilities. The Contractor shall at all times keep the Project site free from accumulations of waste material and rubbish caused by its employees or Work, and shall remove all rubbish as often as it deems necessary or as directed by the Owner or the Architect. Upon completion of the Work, the Contractor shall remove all its rubbish, tools, scaffolding, and surplus materials from and about the Project site, and shall wash all glazing and window frames inside and outside throughout the Project building(s), removing all stains, paint, etc., from same. Care shall be taken not to scratch the glazing in this clean up.

35.2 Standards. All floors and wall coverings shall be left thoroughly clean and finished; all walls and ledges shall be dusted; all plumbing fixtures shall be cleaned; all hardware shall be free of all labels, paint, stains, dust, dirt, and the like; all marks, stains, fingerprints, oil, and dirt shall be removed from painted, decorated, or natural finish Work and the Project building(s) shall be ready for occupancy except for being further equipped by the Owner. In case of dispute, the Owner may perform such cleaning up as may be required and charge the cost to the Contractor.

36.0 NONDISCLOSURE OF CONFIDENTIAL INFORMATION

The Contractor will not disclose to any third person or entity any records or writings of the District, its employees or students, regardless of the form, that are protected by state or federal law and that may come into the Contractor's possession.

37.0 NOTICES

All notices, requests, demands, and other communications given or to be given under this Agreement shall be in writing and shall be deemed to have been duly given when served if served personally, or on the second day after mailing if mailed by first-class mail, registered or certified, postage prepaid, or on the second day after delivery to overnight courier service, in either case properly addressed to the party to whom notice is to be given as set forth below.

If to Owner:

Arriba-Flagler CSD 20
P.O. Box 218
412 Julian Avenue
Flagler, Colorado 80815
Attn: Tom Arensdorf, Superintendant

If to Contractor, then to the individual at the address provided hereinabove.

Either party may change its address for purposes of notice by giving written notice to the other party in accordance with this Section.

38.0 NO ASSIGNMENT

Contractor shall not assign or subcontract any of its rights or obligations hereunder nor any moneys due or to become due under this Agreement without the express written consent of the Owner. Upon any assignment even though consented to by the Owner, the Contractor shall remain liable for the performance of the Work under this Agreement.

39.0 GOVERNING LAW/FORUM SELECTION

This Agreement is made in, will be governed by, and will be construed in accordance with the laws of the State of Colorado. Any legal action by either party to enforce an alleged breach or default shall be brought in the district court in and for Kit Carson County, State of Colorado.

40.0 ATTORNEY'S FEES

In the event it becomes necessary for either party to enforce any provisions or breach of this Agreement by commencing litigation, the prevailing party in such action shall be entitled to collect, as part of any judgment entered, its reasonable expert witness and attorney's fees and costs.

41.0 PARTIAL INVALIDITY

If any provisions of this Agreement are finally determined by a court of competent jurisdiction to be in violation of any statute or rule of law of the State of Colorado, then such provisions shall be deemed null and void to the extent that they may violate applicable law, but without invalidating the remaining provisions hereof.

42.0 WAIVER

Unless expressly made by the Board of Education of the Owner in writing, no waiver of any breach of any one of the agreements, terms, conditions, or covenants of this Agreement by the Owner shall be deemed or imply or constitute a waiver of any other agreement, term, condition, or covenant of this Agreement. The failure of the Owner to insist on strict performance of any agreement, term, condition, or covenant, herein set forth, shall not constitute or be construed as a waiver of the Owner's rights thereafter to enforce any other default; neither shall such failure to insist upon strict performance be deemed sufficient grounds to enable the Contractor to forego or subvert or otherwise disregard any other agreement, term, condition, or covenant of this Agreement.

43.0 COUNTERPARTS

The Agreement may be executed in several counterparts and each such counterpart shall be deemed an original.

44.0 ENTIRE AGREEMENT

This Agreement, together with the documents incorporated herein by reference, contains all of the terms, conditions, and provisions hereof and the entire understanding and all representations of understandings and discussions of the parties relating thereto, and all such prior representations, understandings, and discussions are merged herein and superseded and canceled by this Agreement. This Agreement may only be modified or amended by further agreement executed by the parties hereto.

[Signature Page is Next Page.]

IN WITNESS WHEREOF, the parties have executed this Agreement on the day and year first above written, and shall extend to and bind the parties, their successors, assigns, and personal representatives.

ARRIBA-FLAGLER CONSOLIDATED SCHOOL DISTRICT NO. 20

By:_____
President, Board of Education

ATTEST:

_____
Secretary, Board of Education

CONTRACTOR

By:_____

Its: _____

END OF GENERAL CONDITIONS

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SECTION 01 00 00 – GENERAL CONDITIONS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Division 01 - General Requirements relates to and expands upon the Conditions of the Contract, including the General Conditions and the Supplementary Conditions, but does not supersede requirements specified in those documents or in the Owner/Contractor Agreement.

B. Division 01 - General Requirements governs work under all other divisions of the Specifications, including Project Specifications issued under separate cover, and the Drawings.

1.2 PROJECT IDENTIFICATION AND PRINCIPAL ENTITIES

A. Project Identification and Location:

Flagler School MEP Renovation
Arriba Flagler Consolidated School District 20
421 Julian Avenue
Flagler, Colorado 80815

B. Owner: Wherever the word “Owner” is used in this Project Manual, it shall mean:

Arriba Flagler Consolidated School District 20
421 Julian Avenue
Flagler, Colorado 80815

C. Owner's Representative: Wherever the word “Owner's Representative” is used in this Project Manual, it shall mean:

Leffingwell Consulting Engineers Inc.
1315 North El Paso Street
Colorado Springs, Colorado 80903

D. General Contractor: Wherever the words “Contractor” or “General Contractor” are used in this Project Manual, they shall mean the contractor who is party to the Owner/Contractor Agreement.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. Single Contract: Unless otherwise indicated or specified, all Work indicated on the Drawings and described in the Specifications is to be executed under one prime contract between Owner and General Contractor.

B. Summary of Work: The Work includes selective demolition in and renovation of indicated portions of an existing fire station.

C. The locations of all existing utilities, as indicated on the Drawings, are approximate. General Contractor shall be responsible for verifying location of all underground and above ground utilities indicated on the Architectural, Mechanical, and Electrical Drawings prior to construction. Any damage to these utilities shall be the Contractor’s responsibility and they shall be repaired at no cost to the Owner.

D. Failure to Visit Site: Will not relieve Contractor from necessity of furnishing materials or performing work that may be required to complete the Work in accordance with Drawings and Specifications without additional cost to Owner.

1.4 WORK BY OWNER OR UNDER SEPARATE CONTRACT

A. Work by Others to be Executed During or After Completion of this Contract: 1. Appliances.
   1. Other items indicated to be by Owner, or not in contract (N.I.C.) on Drawings.

B. B Coordination and Cooperation: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Coordinate the Work of this Contract with work performed under separate contracts. Coordinate with the work by others in the review of shop drawings and the exact location of rough-ins for their equipment. Cooperate in the scheduling of work and in the use of space. Furnish and install related items such as rough-in, blocking and structural supports, grouting, electrical rough-in, mechanical rough-in, etc. Coordinate with Architect and engineers.

1.5 ACCESS TO SITE

1. Contractor's Access to Site: Limited to access routes as directed by the Owner.

1.6 COORDINATION WITH OCCUPANTS

A. Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits, unless otherwise indicated.
   1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
      a. Emergency Exits: Maintain all required fire exits from existing building at all times existing building is occupied during construction process.
      b. Exit Doors, Stairways and Discharge Areas: Acceptable to local code authority.
   2. Related Requirements: See Section 01 35 16 Alteration Project Procedures.

B. Disruptive Operations: Noisy and disruptive operations (such use of jack hammers and other noisy equipment):
   1. Schedule and coordinate such operations with Owner.
   2. Upon notification from Owner, cease operations that are, in opinion of Owner, disruptive. Schedule such operations as described above.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Owner not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Owner's written permission.
   3. In general outages shall be scheduled at times coordinated with the Owner.

D. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

E. Construction Parking: Parking for construction labor on site shall be coordinated with the Owner.

F. Owner Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.
   1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied before Owner occupancy.
   2. Obtain a Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
   3. Before partial Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of building.
   4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

1.7 USE OF SITE

A. General: Contractor shall have limited use of premises for construction operations as indicated on Drawings by the Contract limits and as defined at the Pre-construction Conference.

B. Limit use of premises to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
   1. Owner Occupancy: Restrict access to extent required to allow for on-going occupancy of portions of the building outside the area of work.
   2. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
      a. Schedule deliveries to minimize use of driveways and entrances.
      b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

C. Use of Existing Building: Maintain existing building in a weathertight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.
   1. 1. Related Requirements:
      a. Section 01 35 16 Alteration Project Procedures.
      b. Section 01 50 00 Temporary Facilities and Controls.

D. On-Site Work Hours: Work shall be generally performed inside the existing building during normal business working hours, Monday through Friday, unless specifically authorized by the Owner’s Representative.

1.8 WORK SEQUENCE AND CONSTRUCTION PHASING

A. Sequencing of Construction Plan: Before start of construction on site, submit three copies of construction plan regarding access to work; use of site; and scheduling and phasing of new, demolition and renovation work for acceptance by Owner and Architect. After acceptance of plan, construction sequencing shall comply with accepted plan unless deviations are accepted in writing.
   1. No work may commence until Notice to Proceed is provided by the Owner.

1.9 PROJECT UTILITY SOURCES

A. COORDINATE WITH THE FOLLOWING UTILITY COMPANIES PROVIDING PERMANENT SERVICES TO THE PROJECT:
   1. Aquila.
   2. Castle Rock Utilities Department
   3. CenturyLink.

1.10 PROJECT MANUAL FORMATS AND CONVENTIONS

A. MasterFormat: This Project Manual is organized on the basis of the 2004 Edition of the Construction Specifications Institute (CSI) MasterFormat.
   1. In general, Section numbers are assigned six digits. The first two digits identify the Division (Level 1). The next two pairs of numbers, Levels 2 and 3, identify the subject matter of the section in order of increasing hierarchical specificity. In some cases, a Level 4 number is supplied following a decimal point, when clarity requires a higher degree of specificity. Level 5 numbers or letters are not assigned and are reserved for user-defined categories.
   2. The system of groups, subgroups and Divisions are listed in the Table of Contents of this Project Manual. It consists of 50 Divisions, Division 00 though Division 49, some of which are not used or are reserved for future expansion of the MasterFormat.

B. Specification Language: These Specifications are of abbreviated, simplified or streamlined type and include incomplete sentences.
   1. Omissions of words or phrases such as "the contractor shall", "in conformity therewith", "shall be", "as noted on the Drawings", "a", "the", are intentional.
   2. Supply omitted words or phrases by inference.
   3. Supply words "shall be" or "shall" by inference when colon is used within sentences or phrases.
   4. Supply words "on the Drawings" by inference when "as indicated" is used with sentences or phrases.

1.11 EXAMINATION OF SITE

A. Failure to visit the site will in no way relieve any Contractor from the necessity of furnishing materials or performing work that may be required to complete work in accordance with the Contract Documents without additional cost to the OWNER. Bids will be accepted from only those bidders who attend the **mandatory** pre-bid conference at the job site.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION 01 00 00

SECTION 01 01 00 - ALTERNATES

PART 1 - GENERAL

1.1 DESCRIPTION OF REQUIREMENTS

A. Definitions and Explanations: "Alternates" are defined as alternate products, materials, equipment, systems, methods, units of work for major elements of construction, which may, at Owner's option be selected for work in lieu of corresponding requirements of Contract Documents.
   1. Selection may occur prior to Contract Date or may be deferred for possible selection at subsequent date.
   2. Alternates may or may not change scope and general character of work substantially.
   3. Requirements of this section may be related to, but must not be confused with, requirements of Contract Documents related to "unit prices", "change orders", "substitutions" and similar terms.

B. Accepted Alternates: Refer to Owner/Contractor Agreement and subsequent modifications thereof (if any) for determination of which alternates listed have been accepted, and are, therefore, in full force and effect as though originally included in Contract Documents for base bid.

C. Notification: Immediately following award of contract, prepare and distribute to each entity or person to be involved in performance of work, notification of status of each alternate scheduled and including those subsequently added by notification during proposing. Indicate which alternates have been: 1) accepted, 2) rejected, and 3) deferred for consideration at later date as indicated. Include full description of negotiated modifications to alternates, if any.

1.2 GENERAL ALTERNATE REQUIREMENTS

A. Description for each alternate is recognized to be incomplete and abbreviated but implies that each change must be complete for scope of work affected. Refer to applicable sections (Divisions 02 through 49) and to applicable Drawings for specific requirements of each alternate. Modify surrounding work as required to integrate with work of each alternate.

1.3 ADDITIIVE ALTERNATE DESCRIPTIONS

A. Add Alternate No.1: Provide HVAC and electrical modifications for the Cafeteria as described in the Contract Drawings.

B. Add Alternate No 2: Provide HVAC and electrical modifications for the Music room as described in the Contract Drawings.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION 01 01 00

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SECTION 01 02 00 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 PROJECT DESCRIPTION

A. Briefly, and without force and effect on the specifications and drawings, the Project consists of removing existing evaporative cooling units, exhaust fans and supply and exhaust ductwork from various locations throughout the building. New packaged roof top heating and air conditioning units, exhaust fans and supply air and exhaust air ductwork will be installed throughout various locations within the building. A new 3 phase electrical service will be provided for the building and new electrical system (conduit, conductors and panels) provided to serve the new mechanical equipment.

B. Contractor bids shall be due to the Owner's office as indicated in document 00 11 19. All work shall begin May 20, 2013 and shall be completed August 18, 2013. All construction shall be completed and the system shall be complete and operational on August 18, 2013. All submittals shall be submitted to the Owner's Representative by May 19, 2013. All close out documentation shall be submitted to the Owner by September 15, 2013.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. Work covered: Work under this contract includes all materials, equipment and labor necessary to complete the work indicated on the drawings, described in specifications or reasonably inferred.

1.3 CONTRACTORS

A. All work will be executed under one prime construction contract between the Owner and the Contractor. Except as indicated otherwise, all work under this contract will be under the direction of a single prime contractor. Sub contractors may be required to complete various aspects of the work associated with the project scope of work, including mechanical, electrical, painting, demolition, etc.. The prime contractor shall be responsible for completing all work associated with the project scope, including work associated with the sub contractors.

1.4 CONTRACTOR USE OF PREMISES

A. Access to building and work associated with this contract shall be completed during the hours of 6:00 a.m. and 5:00 p.m. on the days that the Contractor is working. The Contractor is responsible for coordinating access to the building with the Owner's personnel. The Contractor is responsible for security of the building entrances under contract at all times. The Contractor may request access to the facility during periods not listed above. The Contractor shall coordinate facility access and security requirements with the Owner in writing.

B. Areas of the building immediately adjacent to areas under construction will be occupied by the Owner during the work of this project. Limit construction operations to those methods and procedures which will not adversely and unduly affect the Owner's occupied spaces.

C. Do not interrupt building access and use, except as permitted by the Owner. Provide 72 hours notice to the Owner of construction activities which will severely impact the occupancy and use of adjacent areas.

D. Temporary barriers and/or partitions will be required to protect the occupants of the building and the general public from injury due to the work of this project and/or to protect adjacent areas of the building from the spread of dust and dirt caused by the work or this project. Locations of certain temporary partitions are shown on the drawings. Remove temporary barriers and partitions upon completion of the Project.

E. Driveways and Entrances: Keep driveways and entrances serving the premises clear and available to the Owner, the Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on site.

F. Do not interrupt power, lighting, plumbing, telephone and HVAC services to occupied areas without the Owner's approval, except for minor interruptions of short duration (less than one hour). Such interruptions must be scheduled at least 24 hours in advance and have the Owner's approval.

G. Use of the Existing Building: Maintain the existing building in a weathertight condition throughout the construction period. Repair damage caused by construction operations. Take all precautions necessary to protect the building and its occupants during the construction period.

H. Full Owner Occupancy: The Owner will occupy the site and existing building during the entire construction period. Cooperate with the Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with the Owner's operations.

1.5 PROTECTION OF WORK AND ADJACENT PROPERTY

A. Buildings and property adjacent to work included in this project may be subject to damage due to construction operations. Prior to the start of the work included in this Contract the Contractor shall photograph the existing condition of adjacent structures and property. Contractor shall provide one set of digital files to the Owner and retain the digital files for their records. Sufficient photos with adequate detail to thoroughly document the conditions surrounding the work shall be provided. Video recordings will be accepted as a substitute to photographs.

B. At the completion of the project, Contractor shall restore existing buildings, landscaping and property to same condition as prior to the start of the work. All physical damage shall be cleaned to the condition prior to commencement of work or replaced with new materials.

C. The Contractor shall notify, in writing, the Owner of private property which interferes with the work and arrange with them for disposition of such property.

1.6 CONTRACTOR'S ACCESS PARKING AND STAGING AREAS

A. Work included in this project will need to be performed within the limitations of available access at the site. Contractor shall adjust the means and methods of construction to allow for the restrictions surrounding the site. Access to the building and staging areas for the Contractors and sub-contractor's operations will be covered in the pre-bid conference and further detailed during the pre-construction meeting.

B. All parking in campus parking lots is under the control and authority of the Owner. Parking for individual cars within project limit lines on campus lots is limited. There is no parking fee for such parking.

PART 2 - NOT USED

PART 3 - NOT USED

END OF SECTION 01 02 00

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SECTION 01 03 00 - ADMINISTRATION AND SUPERVISION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and other Specification sections, apply to work of this section.

1.2 SURVEYS, LAYOUTS, AND LEVELS

A. General: Working from lines and levels established by the existing building, and as shown in relation to the work, establish and maintain bench marks and other dependable markers to set the lines and levels for the work of construction as needed to properly locate every element of the work of the entire project. Calculate and measure required dimensions as shown (within recognized tolerances if not otherwise indicated); do not scale the drawings to determine dimensions. Continuously advise tradesmen performing the work of the marked lines and levels provided for use in the layout of work.

1.3 SUBMITTALS

A. Within 10 days of the Notice to Proceed, the Contractor shall submit a Schedule of Values to be used in determining general progress of the project, and for determining percentage of work accomplished for progress payments. As a minimum, the Schedule of Values shall indicate the value of materials and labor for each major category of work. The value of materials and labor shall be shown separately.

1.4 PROGRESS SCHEDULE

A. Furnish Project Schedule, as required by the General Conditions, not less than four copies in the form of: Bar chart, showing start and completion of each activity or unit of work and overall percentage of completion against time. Provide such details as required by the Consultant. The Contractor shall provide a detailed construction schedule within two weeks of the award and identify all materials with a lead time greater than 30 days. The Contractor shall provide weekly updates to the construction schedule throughout the duration of the project.

1.5 PROJECT RECORD DOCUMENTS

A. Maintain at job site, one copy of:
   1. Contract Drawings
   2. Specifications
   3. Addenda
   4. Reviewed Shop Drawings
   5. Change Orders
   6. Other Modifications to Contract
   7. Field Test Records
   8. As-Built Drawings

B. Maintain documents in clean, dry, legible condition and do not use record documents for construction purposes. Make documents available at all times for inspection by the Owner's Representative.

C. Label each document "Project Record" in 1" or larger printed letters.

D. Record drawing information in colored pencil with different colors for the various systems and defined by color legend.

E. Record drawings and specifications shall include the following:
   1. Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure. Location of concealed valves, dampers, controls, balancing devices, junction boxes, cleanouts, and other items requiring access or maintenance.
   2. Field changes of dimension and detail, changes made by Change Order or Field Order and details not on original contract drawings.

F. Submit all record drawings to the Consultant at the completion of the project.

1.6 CLEANING

A. Cleaning and Protection Work: At the time each unit of work or element of the construction is completed in each area of the Project, clean the unit or element to a condition suitable for occupancy and use (as intended), and restore minor or superficial damage. Replace units and elements which are damaged beyond successful restoration. Clean and restore adjoining surfaces and other work which was soiled or damaged (superficially) during the installation; replace other work damaged beyond successful restoration. Where the performance of subsequent work could possibly result in damage to the complete unit or element, provide protective covering or other provisions to minimize possible damage. Repeat cleaning and protection operations during remainder of construction period, wherever work might otherwise be damaged by sustained soiling or exposure.

B. During Construction: Oversee cleaning and ensure that building, grounds, and public properties are maintained free from accumulation of waste materials and rubbish. At reasonable intervals during progress of work, clean up site and access and dispose of waste materials, rubbish, and debris. Grounds around the access areas shall be broom clean by the end of each day.

C. Final Cleaning: Remove all discarded materials and equipment. Restore sidewalks, lawns, landscaping, driveways, etc. to the condition prior to commencement of work.

1.7 PROJECT SIGN

A. A project sign is not required. Do not erect any project sign or jobsite sign of any kind, except warning signs, without written authorization of the Owner.

1.8 COORDINATION

A. The Contractor shall coordinate the work so as not to interfere with the building custodian's normal cleanup activities.

B. The Contractor shall be responsible for coordinating all the work of the project. The Contractor shall coordinate the efforts of all subcontractor(s) and the deliveries of suppliers so that the work progresses in an orderly fashion without delay towards timely completion of a complete project in accordance with the drawings and specifications.

C. The Contractor shall note that concurrent with his work, other contractors, suppliers, and the District's facilities and maintenance personnel may be working in relatively close proximity. The Contractor will be solely responsible for coordinating his work with that of other contractors and will make no claims for failure to do so.

1.9 METHODS OF CONSTRUCTION

A. The procedure and method of construction is the prerogative and the responsibility of the Contractor. If professional assistance is required to safely implement method of construction, the Contractor shall, on his own, employ professional help.

PART 2 - NOT USED

PART 3 - NOT USED

END OF SECTION 01 03 00

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SECTION 01 04 00 - PROJECT COORDINATION

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 work of this section.

1.2 SUMMARY:

A. Section Includes: Requirements for coordination, supervision and administration for Project, including but not necessarily limited to:
   1. Coordination.
   2. Administrative and supervisory personnel.
   3. General installation provisions.
   4. Cleaning and protection.

B. Related Sections: For descriptions of the work of the entire Project within and outside of the work of this Contract: Section 01 01 00.

1.3 SUBMITTALS:

A. Coordination Drawings: For locations where several elements of equipment, mechanical or combined mechanical and electrical work must be sequenced and positioned with precision in order to fit into the available space, prepare coordination shop drawings showing the actual physical dimensions at accurate scale required for the installation. Prepare and submit coordination drawings prior to purchase/fabrication/installation of any of the elements involved in the coordination.

B. Staff Names: Within 10 days of Notice to Proceed, submit a list of the Contractor's principal staff assignments, including the Superintendent in attendance at the site. Submit addresses and telephone numbers, including after-hours telephone numbers for emergency response.

1.4 GENERAL COORDINATION:

A. General: Each entity involved in the performance of work for the entire Project shall cooperate in the overall coordination of the work; promptly, when requested, furnish information concerning its portion of the work; and respond promptly and reasonably to the decisions and requests of persons designated with coordination, supervisory, administrative, or similar authority. Where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination.

B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction work. Such administrative activities include, but are not limited to, the following:
   1. Preparation of schedules.
   2. Installation and removal of temporary facilities.
   3. Delivery and processing of submittals.
   4. Progress meetings.
   5. Project closeout activities.

C. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water and materials. Salvage materials and equipment involved in performance of, but not actually incorporated in, the Work. Refer to other sections for disposition of salvaged materials that are designated as the District's property.

D. Site Utilization: In addition to the site utilization limitations and requirements indicated in Section 01010 and indicated by the Contract Documents, administer the allocation of available space equitably among entities needing access and space, so as to produce the best overall efficiency in the performance of the total work of the project. Schedule deliveries so as to minimize the space and time requirements for storage of materials and equipment on the site; but do not unduly risk delays in the work.

1. The Contractor shall note that concurrent with his work, other contractors, suppliers, and the District's facilities and maintenance personnel may be working in relatively close proximity. The Contractor will be solely responsible for coordinating his work with that of other contractors and will make no claims for failure to do so.

E. Coordination Meetings: Where necessary, schedule coordination meetings for this purpose on an as-needed basis.

F. Layout: It is recognized that the Contract Documents are diagrammatic in showing certain physical relationships of the various elements and systems and their interfacing with other elements and systems. Establishment and coordination of these relationships is the exclusive responsibility of the Contractor. Do not scale the drawings. Field measure all conditions prior to fabrication and construction. Lay out and arrange all elements to contribute to safety, efficiency and to carry the harmony of design throughout the Work. In case of conflict or undimensioned locations, verify required positioning with the Owner’s Representative.

G. Substrate Examination: The Installer of each element of the work must examine the conditions of the substrate to receive the work, dimensions and spaces adjacent, tolerances, interfacing with other elements and services, and the conditions under which the work will be performed, and must notify the Contractor in writing of conditions detrimental to the proper or timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

H. Large and Heavy Equipment and Materials: Coordinate the movement of heavy items with shoring and bracing, so that the building structure will not be overloaded during the movement and installation. Where equipment or products to be installed on the roof are too heavy to be hand-carried, do not transport across roof deck; position by crane or other device so as to avoid overloading the roof deck.

1.5 COMPLETE SYSTEMS:

A. It is the intent of the Contract Documents that all systems, including mechanical and electrical, be complete and functional to provide the intended or specified performance. The Contractor shall provide all incidental items and parts necessary to achieve this requirement.

B. Provide correctly sized power, utilities, piping, drains, services and their connections to equipment and systems requiring them, whether or not specific items are listed in the schedule at the end of this section.

1.6 MECHANICAL/ELECTRICAL/EQUIPMENT COORDINATION:

A. Sequence, coordinate and integrate the various elements of equipment, mechanical work and electrical work so that various systems and mechanical plant will perform as indicated and be in harmony with other work of the building. The Owner’s Representative, including the Project Architect or Engineer, will supervise the coordination, which is the exclusive responsibility of the Contractor.

B. Install piping, ductwork and similar services straight and true, aligned with other work, close to walls and overhead structure, allowing for insulation, concealed (except where indicated as exposed) in occupied spaces, and out-of-the-way with maximum passageway and headroom remaining in each space.

C. Install electrical work in a neat, organized manner with conduit and similar services in or parallel with building lines, and concealed unless indicated as exposed.

D. Arrange all work to facilitate maintenance and repair or replacement of equipment. Locate services requiring maintenance on valves and similar units in front of services requiring less maintenance. Connect equipment for ease of disconnecting, with minimum of interference with other work.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION PROCEDURES:

A. Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.

B. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items.

C. Recheck measurements and dimensions, before starting fabrication or installation.

D. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.

E. Installation: Provide attachment and connection devices and methods necessary for securing work. Secure work true to line and level. Allow for expansion and building movement. Install each component during weather conditions and project status that will ensure the best possible results. Isolate each part of the completed construction from incompatible material as necessary to prevent deterioration. Coordinate temporary enclosures with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.

F. Visual Effects: Provide uniform joint widths in exposed work. Arrange joints in exposed work to obtain the best visual effect. Refer questionable choices to the Owner’s Representative for final decision.

G. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated. Refer questionable mounting height decisions to the Owner’s Representative for final decision.

3.2 CLEANING AND PROTECTION:

A. During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from damage or deterioration at substantial completion.

B. Clean and maintain completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

C. Limiting Exposures: Supervise construction activities to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:
   1. Excessive static or dynamic loading.
   2. Water or ice.
   3. Solvents.
   4. Chemicals.
   5. Puncture.
   6. Abrasion.
   7. Heavy traffic.
   8. Soiling, staining and corrosion.
   9. Unusual wear or other misuse.
   10. Contact between incompatible materials.
   11. Misalignment.
   12. Excessive weathering.
   13. Unprotected storage.
   14. Improper shipping or handling.
   15. Theft.
   16. Vandalism.

END OF SECTION 01 04 00

SECTION 01 09 00 - REFERENCE STANDARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification sections, apply to work of this section.

B. Administration, Procedures, Codes.

1.2 SUMMARY:

A. Section Includes: General information and listing of reference standards.

1.3 REFERENCE STANDARDS:

A. Applicability of Standards: Except where Contract Documents include more explicit or stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into Contract Documents. Such standards are made a part of the Contract Documents by reference. Individual Sections indicate which codes and standards the Contractor must keep available at the project site for reference. Referenced standards take precedence over standards that are not referenced but generally recognized in the construction industry as applicable.

B. Conflicting Requirements: Where compliance with two or more standards is specified, and they establish different or conflicting requirements for minimum quantities or quality levels, the most stringent requirement will be enforced, unless the Contract Documents indicate otherwise. Refer requirements that are different, but apparently equal, and uncertainties as to which quality level is more stringent to the Owner's Representative for a decision before proceeding.

C. Unreferenced Standards: Unreferenced standards are not directly applicable to the Work, except as a general requirement of whether the Work complies with recognized construction industry standards.

D. Publication Dates: Where compliance with an industry standard is required, comply with standard in effect as of date of Contract Documents.

E. Updated Standards: At the request of the Owner, Contractor or authority having jurisdiction, submit a Change Order proposal where an applicable code or standard has been revised and reissued after the date of the Contract Documents and before performance of Work affected. The Owner will decide whether to issue a Change Order to proceed with the updated standard.

F. Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to that entity's construction activities. Copies of applicable standards are not bound with the Contract Documents.

G. Where copies of standards are needed for proper performance of a recognized construction activity, the Contractor shall obtain copies directly from the publication source.

H. Although copies of standards needed for enforcement of requirements may be part of required submittals, the Owner reserves the right to require the Contractor to submit additional copies as necessary for enforcement of requirements.

PART 2 - PRODUCTS (Not applicable)

PART 3 - EXECUTION (Not applicable)

END OF SECTION 01 09 00

SECTION 01 15 00 - ADMINISTRATION, PROCEDURES, CODES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1-Specification sections, apply to work of this section.

B. Reference Standards.

1.2 SUMMARY:

A. Section Includes: General administrative requirements and procedures and related applicable codes.

1.3 CODES:

A. Obtain all permits, inspections, approvals, and certificates required by law. Conform to all laws, ordinances, rules and regulations applicable to the location of the Project.

B. Governing Regulations: In addition to the above, conform to the following standards and regulations:
1. International Building Code, 2012 edition.
2. International Mechanical Code, 2012 edition.
3. International Plumbing Code, 2012 edition.
4. International Fire Code, 2012 edition.
5. National Electric Code, 2012 edition (NFPA No. 70).
6. All State regulations.

C. Publication Dates: Comply with codes and standards in effect at the date of the Contract Documents, except where a standard of a specific date or edition is indicated.

1.4 ATTACHMENTS TO CONCRETE:

A. No drilled inserts or powder-actuated fasteners are permitted by any trade in pre-stressed concrete except as specifically authorized by the General Contractor and carried out under the direct supervision of his Superintendent.

B. Only those devices with a maximum controlled penetration of 0.75" or less will be permitted, unless specifically indicated on the structural details in the Project Drawings. Make holes through slabs by means of sleeves placed no closer than 2" from tensioning cables. Core drilling will not be permitted unless unavoidable and as specified in Section 01045.

1.5 CONTRACTOR'S CONSTRUCTION SCHEDULE:

A. Furnish Construction Schedule, as required by General Conditions, not less than 4 copies. Prepare the schedule on a sheet, or series of sheets, of stable transparency, or other reproducible media, of sufficient width to show data for the entire construction period.

B. Secure time commitments for performing critical elements of the Work from parties involved. Coordinate each element on the schedule with other construction activities; include minor elements involved in the sequence of the Work. Show each activity in proper sequence. Indicate graphically sequences necessary for completion of related portions of the Work.

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

D. Bar Chart Schedule:
   1. Prepare a fully developed, horizontal bar chart type Contractor's construction schedule. Submit within 30 days of the date established for "Commencement of the Work".
   2. Provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week. Use the same breakdown of units of the Work as indicated in the "Schedule of Values".
   3. Within each time bar, indicate estimated completion percentage in 10% increments. As Work progresses, place a contrasting mark in each bar to indicate Actual Completion.
   4. Include listing of Subcontractors, suppliers and materials men with name of contact person, address and phone number

E. Updating:
   1. The schedules shall be updated and reissued weekly and shall reflect actual job progress, delays or gains of time and any rescheduling. The original schedule and each updating shall be furnished in 4 copies to the Owner’s Representative. All costs for this scheduling shall be borne by the Contractor. Submit Owner’s Representative copies as a part of each pay request which will not be processed without such updates.
   2. When schedule revisions affect the submittals schedule, revise that schedule and submit to Owner’s Representative with revised Construction Schedule.

1.6 DELIVERY, STORAGE AND HANDLING:

A. Properly carton, crate, cover and protect materials, products and equipment for shipping, handling and storing. Use appropriate means for hoisting and loading which will prevent damage or overstress to items being handled or shipped. Store them under roof in controlled environment whenever feasible otherwise store off the ground under suitable coverings properly secured against wind and weather. Protect all items from rain, snow, moisture, wind, cold, heat, frost, sun, staining, discoloration, deterioration and physical damage from any cause. Refer to individual sections for specific requirements.

1.7 ENVIRONMENTAL HEALTH AND SAFETY:

A. Physical, Life, and Fire Safety: There will be joint contractor and District responsibilities to control physical hazards (i.e., compressed gases, welding, electrical, safety netting, cranes, scaffolding, supplies on the roof and electrical) which may endanger the health of contractor or District employees, students, patients, and visitors as may cause property damage.

B. During the construction phase, the district's Physical Plant staff will monitor all construction projects for compliance with acceptable safety practices. The following minimum items are included:
   1. Exit corridors and exit doors will not be blocked without making prior arrangements for alternate exit routes.
   2. Contractor will provide physical barriers with appropriate warning signage to protect public areas from construction work.
   3. Contractor will conduct daily inspections to eliminate fire hazards and any other safety hazards which may adversely affect District employees, students, visitors, and patients.
   4. Contractor will provide signs used for proper identification of construction areas.
   5. Contractor will provide an adequate number of fire extinguishers to be available on-site for emergency use in the construction area.
   6. Contractor and Owner will provide emergency notification phone numbers to be posted in all construction areas.

C. OSHA Hazard Communication Standard:
   1. Every Contractor or subcontractor performing work shall have to comply with this standard. Compliance includes joint Owner and Contractor responsibilities for the purpose of providing timely communications and information sharing with regard to hazardous materials and chemicals and chemical sources which may be present on-site or brought in by the Contractor. Owner's Physical Plant representatives will discuss right-to-know issues with the Contractor or his representative during the pre-construction conference(s).
   2. Owner will provide Contractor with the following:
      a. Information regarding hazardous chemicals and agents to which they may be exposed while on the job site. Medical Safety Data Sheets (MSDSs) will be provided by the District.
      b. Precautions that employees shall take to lessen the possibility for exposure by employment of appropriate protective measures.
      c. Precautionary methods to take in a foreseeable emergency.
   3. The Contractor is responsible for all safety training and environmental surveillance of their workers.
   4. The Contractor shall inform and provide designated Owner’s Representative with the following information:
      a. Material safety data sheets for all chemicals they introduce into the workplace(s).
      b. The information regarding potential sources of pollutants which may be entrained in District's air intakes (i.e., roofing tar fumes, nuisance dusts, exhaust from internal combustion engines, welding or cutting fumes, and asbestos - if damaged or encountered during the course of their work.

D. Asbestos Control: There may be asbestos containing materials within the existing building where work will be performed under this contract.
   1. The presence of asbestos-containing materials on the job site does not mean a problem exists. Areas where asbestos is friable and not contained are of concern.
   2. There are several District and Contractor responsibilities regarding asbestos. These are:
      a. The District Shall:
         1) Notify the Contractor of the condition and location(s) where asbestos is known to be present or may be reasonably be encountered (i.e., insulations, ceiling tiles, floor tiles, fire doors, wall and ceiling plasters, concrete, grouting, etc.).
         2) Request that undamaged asbestos-containing materials are not damaged.
         3) Require Contractors to report suspected asbestos problems to the District.
         4) Require that the Contractor train and monitor their own employees where applicable.
         5) Coordinate with the Contractor when response action is required by either the District's Asbestos Abatement Team or by a Subcontractor.

6) Monitor areas where friable asbestos is present during construction/renovation projects for its own records and purpose. Monitoring results can be shared with Contractors but are in no way to be used for Contractor employee monitoring.
7) Have the final word on all asbestos-related concerns and contractual arrangements.

b. The Contractor Shall:
1) Notify the Owner of any suspected or existing problem involving asbestos and cease work in that area until the Owner has assessed the situation.
2) Be responsible for all environmental/industrial hygiene surveillance of their work staff and subcontractors.
3) Not create problems which can result in asbestos exposure to building occupants.

E. Carcinogenics: Contractor or any subcontractor shall not knowingly install or cause to be installed any material or product containing carcinogenics.

PART 2 - PRODUCTS (Not applicable)

PART 3 - EXECUTION (Not applicable)

END OF SECTION 01 15 00

SECTION 01 30 00 - SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification sections, apply to work of this section.

1.2 SUMMARY:

A. Section Includes: Administrative and procedural requirements for submittal and review of product data, shop drawings, samples and similar items required by the specifications.

1.3 ADMINISTRATIVE SUBMITTALS:

A. Refer to other Division-1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to:
   1. Schedules.
   2. Permits.
   3. Applications for payment.
   4. Performance and payment bonds.
   5. Insurance certificates.
   6. List of Subcontractors.
   7. Schedule of Values.
   8. Inspection and test results.
   9. Closeout documents.
   10. Coordination drawings.

B. Administrative submittals are for information and record and do not require action on the part of the Owner’s Representative except where not in conformity with the Contract Documents. If such non-conformity is observed, the Owner’s Representative will notify the Contractor within two weeks of the Owner’s Representative's actual receipt of the non-comforming document. Failure to observe or notify by the Owner’s Representative on any issue does not relieve Contractor of compliance with Contract Documents.

1.4 SUBMITTAL LOG

A. A submittal Log is included at the end of this section. The Contractor is required to submit information pertaining to each of the listed items. the Contractor may also The Contractor shall update the Submittal Log on a timely basis, and shall bring the log to scheduled progress meetings for coordination and review.

1.5 SUBMITTAL PROCEDURES:

A. General: the Contractor shall make submittals to the Owner's Representative only after the Contractor has reviewed and fully coordinated all aspects of construction regarding each submittal. the Contractor shall indicate his action except for samples and selection submittals.

B. Submittals which lack the Contractor's review, coordination, and action will be returned to the Contractor without action.

C. Coordination: Coordinate the preparation and processing of submittals with the performance of construction activities. The Contractor shall transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay. the contractor is wholly responsible for the submittal process, its timing, and any related delay.
   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 elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.
   3. Distribute submittals to related subcontractors for comment to assure the timely coordination of the work.
   4. The Owner's Representative reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
   5. If, during the Contractor's submittal review, any inconsistency, conflict, or deviation from or with the Contract Documents becomes apparent, it is the Contractor's responsibility to inform the Owner's Representative immediately of all concerns in writing.

D. Processing: To avoid the need to delay installation as a result of the time required to process submittals, allow sufficient time for submittal review, **including time for resubmittals.**
   1. Allow 2 weeks from receipt of the submittal by the Owner's Representative for initial review. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. The Owner's Representative will advise the Contractor when a submittal being processed must be delayed for coordination.
   2. If an intermediate submittal is necessary, process the same as the initial submittal.
   3. Allow 2 weeks from receipt of the submittal by the Owner's Representative for reprocessing each submittal.
   4. No extension of Contract Time will be authorized because of failure to transmit submittals to the Owner's Representative sufficiently in advance of the Work to permit processing, including resubmittals of incomplete or rejected submittal items.

E. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.
   1. Provide a space approximately 4" x 5" on the label or beside the title block on Shop Drawings to record the Contractor's review and approval markings and the action taken.
   2. Include the following information on the label for processing and recording action taken.
      a. Project name.
      b. Date.
      c. Name and address of Contractor.
      d. Name and address of Subcontractor.
      e. Name of manufacturer.
      f. Number and title of appropriate Specification Section.

F. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from Contractor to Owner's Representative using a transmittal form. Submittals received from sources other than the Contractor will not be returned.

1. On the transmittal, record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including minor variations and limitations. Include Contractor's certification that information complies with Contract Document requirements.

G. Submittal Reviews:

1. The Owner's Representative will provide two submittal reviews, one initial review and one follow up review. After the second review, if the submittals do not meet the requirements of the Contract Documents, the Contractor shall provide compensation to the Owner's Representative for additional submittal reviews.

1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Prepare a fully developed, horizontal bar-chart-type, contractor's construction schedule. Submit within 14 days after the date established for "Commencement of the Work" or "Notice to Proceed."

1. Provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week. Use the same breakdown of units of the Work as indicated in the "Schedule of Values."
2. Within each time bar, indicate estimated completion percentage in 10 percent increments. As Work progresses, place a contrasting mark in each bar to indicate Actual Completion.
3. Prepare the schedule on a sheet, or series of sheets, of stable transparency, or other reproducible media, of sufficient width to show data for the entire construction period.
4. Secure time commitments for performing critical elements of the Work from parties involved. Coordinate each element on the schedule with other construction activities; include minor elements involved in the sequence of the Work. Show each activity in proper sequence. Indicate graphically the sequences necessary for completion of related portions of the Work.
5. Coordinate the Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittal Schedule, progress reports, payment requests, and other schedules.
6. Indicate completion in advance of the date established for Substantial Completion. Indicate Substantial Completion on the schedule to allow time for the Owner's Representative's procedures necessary for certification of Substantial Completion.

B. Schedule Updating: Revise the schedule after each meeting, event, or activity where revisions have been recognized or made. Issue the updated schedule concurrently with the report of each meeting. Schedule updating is required prior to the processing of all Contractor's application for payment.

1.7 SHOP DRAWINGS:

A. Submit newly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not considered Shop Drawings. Do not use Shop Drawings without an appropriate final stamp indicating action taken.

B. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings. Include the following information:

1. Dimensions.
2. Identification of products and materials included.
3. Compliance with specified standards.
4. Notation of coordination requirements.
5. Notation of dimensions established by field measurement.

C. Initial Submittal: Submit one correctable, translucent, reproducible print and one blue- or black-line print each for the Owner's Representative's review. The Owner's Representative will return the reproducible print. The Contractor will provide prints of marked up sepia as may be required for his use and that of his Subcontractors and suppliers.

D. Final Submittal: Submit 6 copies for final action by the Owner's Representative. The Owner's Representative shall return one copy to the Contractor. The Contractor shall be responsible for procuring copies of the final submittal so that desired distribution can be made to the Contractor's field office, his home office, the Record Documents, the fabricator, and any others requiring in the submittal.

E. Where shop drawings are indicated to be submitted for "information only", submit three sets of prints to Owner's Representative and retain one set for Project Record Documents.

1.8 PRODUCT DATA:

A. Collect **ALL** Product Data into a single submittal for each element of construction or system. Product Data includes printed information such as manufacturer's installation instructions, catalog cuts, standard or special color charts, rough-in diagrams and templates, standard wiring diagrams and performance curves. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as "Shop Drawings". Product Data Submittal shall be provided in a vinyl covered 8 ½"x11" 3-ring binder. Product Data shall be organized within the binder into sections corresponding to specification sections. Provide a labeled tabbed divider between each section. Provide an index and a Contractor and Owner contact page at the front of the binder page.

B. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate the applicable information. Include the following information.
1. Manufacturer's printed recommendations.
2. Compliance with recognized trade association standards.
3. Compliance with recognized testing agency standards.
4. Application of testing agency labels and seals.
5. Notation of dimensions verified by field measurement.
6. Notation of coordination requirements.

C. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed by the Contractor.

D. Initial Submittal: Submit 6 copies for action by the Owner's Representative. The Owner's Representative shall return one copy to the Contractor. The Contractor shall be responsible for procuring copies of the final submittal so that desired distribution can be made to the Contractor's field office, his home office, the Record Documents, the fabricator, and any others involved in the submittal.

E. Submittal is for information and record, unless otherwise indicated; and therefore, initial submittal is final submittal unless returned by the Owner's Representative marked with a revise and resubmit action which indicates an observed non-compliance.

1.9 SELECTIONS SUBMITTAL:

A. Where selections of colors, patterns, textures are specified to be made by the Owner's Representative, assemble complete samples of all specified or approved products for all specification sections and submit to Owner's Representative. Review specifications and assemble all such samples for a combined single submittal. Indicate on the transmittal the latest date for selections to be made for each item to permit delivery of material in accordance with Progress Schedule. Allow a minimum of two weeks for Owner's Representative's action. Owner's Representative's action is limited solely to the specified selections or rejection of submittal items not in accordance with Specifications.

1.10 QUALITY ASSURANCE SUBMITTALS

A. Submit quality-control submittals, including design data, certifications, manufacturer's instructions, manufacturer's field reports, and other quality-control submittals as required under other Sections of the Specifications.

B. Certifications: Where other Sections of the Specifications require certification that a product, material, or installation complies with specified requirements, submit a notarized certification from the manufacturer certifying compliance with specified requirements.
   1. Signature: Certification shall be signed by an officer of the manufacturer or other individual authorized to sign documents on behalf of the company.

C. Inspection and Test Reports: Where standard tests are specified for products, including equipment, which tests are not performed at the job site, follow procedures for Product Data. For field inspection and tests specified to be performed by independent agencies, such agencies shall transmit directly one copy each to the Owner's Representative, his consulting engineer where applicable, and the Contractor with an extra copy for Record Documents.

1.11 OWNER'S REPRESENTATIVE'S ACTION

A. Except for submittals for the record or information, where action and return is required, the Owner's Representative will review each submittal, mark to indicate action taken, and return to the Contractor.
   1. Compliance with specified characteristics is the Contractor's responsibility.

B. Action Stamp: The Owner's Representative will stamp each submittal with a uniform, action stamp. The Owner's Representative will mark the stamp appropriately to indicate the action taken, as follows:
   1. Final Unrestricted Release: When the Owner's Representative marks a submittal "No Exception Taken," the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents. Final payment depends on that compliance.
   2. Final-But-Restricted Release: When the Owner's Representative marks a submittal "Make Corrections Noted," the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents. Final payment depends on that compliance.
   3. Returned for Resubmittal: When the Owner's Representative marks a submittal "Revise and Resubmit," do not proceed with Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal according to the notations; resubmit without delay. Repeat if necessary to obtain different action mark.
      a. Do not use, or allow others to use, submittals marked "Revise and Resubmit" at the Project Site or elsewhere where Work is in progress.

4. Other Action: Where a submittal is for information or record purposes or special processing or other activity, the Owner's Representative will return the submittal marked "Action Not Required."

C. Unsolicited Submittals: The Owner's Representative will return unsolicited submittals to the sender without action.

PART 2 - PRODUCTS (Not applicable)

PART 3 - EXECUTION (Not applicable)

END OF SECTION 01 30 00

SECTION 01 45 00 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification sections, apply to work of this section.

1.2 SUMMARY

A. Work Included: This section establishes general requirements in addition to those indicated in the General Conditions of the Contract for Construction pertaining to cutting, fitting, and patching of the work required to:
   1. Make the several parts fit properly.
   2. Uncover work to provide for installation, inspection, or both, of ill-timed work.
   3. Remove and replace work not conforming to requirements of Contract Documents.
   4. Patch new construction into existing construction.

B. Related Work:
   1. In addition to requirements specified, upon the Consultant's request, uncover work to provide for inspection of covered work, and remove samples of installed materials for testing.
   2. Do not cut or alter work performed under separate contract without the Consultant's written permission.

1.3 DEFINITION:

A. "Cutting and patching" is hereby defined to include but is not necessarily limited to the cutting and patching of nominally completed and previously existing work, in order to accommodate the listed requirements. Cutting and patching is further defined to include integral cutting and patching during the manufacturing, fabricating, erecting and installing process for individual units of work.

B. Demolition is recognized as an example of a related but separate category of work, which may also require cutting and patching as defined in this section; refer to Selective Demolition Section.

1.4 RESPONSIBILITIES:

A. Contractor shall be responsible for all cutting, fitting and patching, including attendant excavation and backfill, required to complete the Work or to:
   1. Make its several parts fit together properly.
   2. Uncover portions of the Work to provide for installation of ill-timed work.
   3. Remove and replace defective work or work not conforming to requirements of Contract Documents.
   4. Remove samples of installed work as specified for testing.
   5. Provide routine penetrations of structural and non-structural surfaces for installation of mechanical and electrical work.

B. Refer to other sections of the specifications for specific cutting and patching requirements and limitations applicable to individual units of work.

1.5 SUBMITTALS:

A. Proposals for Cutting and Patching: Submit a written request to the Owner's Representative well in advance of executing any cutting or alteration which affects:
   1. Work of the District or any separate contractor.
   2. Structural value or integrity of any element of the Project.
   3. Integrity or effectiveness of weather exposed or moisture-resistant elements or systems.
   4. Efficiency, operational life, maintenance or safety of operational elements.
   5. Visual qualities of sight-exposed elements.
   6. Cutting new openings in existing structural concrete walls, floors and suspended slabs.
   7. Cutting new openings in existing roofs and roofing materials.
   8. Cutting exterior walls.
   9. Cutting into shafts.

B. Include description of why cutting and patching cannot reasonably be avoided, how it will be performed, how structural elements will be reinforced, products to be used, firms and trades to perform the work, approximate dates of the work, and anticipated results in terms of variations from the work as originally completed (structural, operational, visual and other qualities of significance).

C. List utilities that will be disturbed or otherwise affected by work, including those that will be relocated and those that will be out-of- service temporarily. Indicate how long utility service will be disrupted.

D. Where cutting and patching involves addition of reinforcement to structural elements, submit details and engineering calculations, from a Licensed Professional Engineer, to show how reinforcement is integrated with the original structure.

E. Approval by Owner's Representative to proceed with proposed cutting-and-patching does not waive his right to later require complete removal and replacement of work found to be unsatisfactorily cut-and-patched.

1.6 QUALITY ASSURANCE:

A. Requirements for Structural Work: Do not cut and patch structural work in a manner resulting in a reduction of load-carrying capacity or load/deflection ratio.

B. Operational and Safety Limitations: Do not cut and patch operational elements and safety-related components in a manner resulting in a reduction of capacities to perform in the manner intended or resulting in decreased operational life, increased maintenance, or decreased safety.

C. Visual Requirements: Do not cut and patch work which is exposed on the exterior or exposed in occupied spaces of the building, in a manner resulting in a reduction of visual qualities or resulting in substantial evidence of the cut-and-patch work, both as judged solely by the Owner's Representative. Remove and replace work judged by the Owner's Representative to be cut-and-patched unsatisfactorily, visually.

1.7 PROJECT CONDITIONS:

A. Where cutting and patching of existing construction is required, prior to start of work, inform Owner of existing construction to be disturbed. Owner will determine if existing construction contains asbestos. Do not proceed with work until Owner has made an examination. Refer to Section 01105.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Use materials that are identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to visual effect. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Inspect existing conditions of Project, including elements subject to damage or to movement during cutting and patching.

B. After uncovering work, inspect conditions affecting installation of products, or performance of work.

C. Report unsatisfactory or questionable conditions to the Owner's Representative in writing; do not proceed with work until Owner's Representative has provided further instructions.

3.2 PREPARATION:

A. Temporary Support: Provide adequate support for work to be cut, to prevent failure. Do not endanger other work.

B. Protection: Provide adequate protection of other work during cutting-and-patching, to prevent damage; and provide protection of the work from adverse weather exposure. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas. Take all precautions necessary to avoid cutting existing pipe, conduit or ductwork serving the building, but scheduled to be removed or relocated until provisions have been made to bypass them.

3.3 CUTTING AND PATCHING:

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. Cutting: Cut work by methods least likely to damage work to be retained and work adjoining. Review proposed procedure with original Installer where possible, and comply with his recommendations. Cut holes and slots neatly to size required and temporarily cover openings when not in use.
   2. In general, cut work with sawing and grinding tools. Do not use hammering and chopping tools. Core drill openings through concrete work where possible.
   3. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
   4. Cut through concrete and masonry using a cutting machine such as a Carborundum saw or diamond core drill.
   5. Fit work airtight to pipes, sleeves, ducts, conduit and other penetrations through surfaces.

B. Patching: Patch with seams which are durable and as invisible as possible. Comply with specified tolerances for the work. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.

1. Restore exposed finishes of patched areas; and, where necessary extend finish restoration onto retained work adjoining, in a manner which will eliminate evidence of patching. Where a patch occurs in a smooth painted surface, extend final paint coat over the entire unbroken surface containing the patch.
2. Where removal of walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space to provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary to achieve uniform color and appearance.
3. Patch, repair or re-hang existing ceilings as necessary to provide an even plane surface of uniform appearance.

END OF SECTION 01 45 00

SECTION 01 54 00 - SAFETY AND HEALTH

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and other Specification sections, apply to work of this section.

1.2 WORK COVERED BY THIS SECTION

A. This section is applicable to all work covered by this contract.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. OSHA General Industry and Health Standards (29 CFR 1910), Publications V2206; OSHA Construction Industry Standards (29 CFR 1926). One source of these regulations is OSHA Publication 2207, which includes a combination of both Parts 1910 and 1926 as they relate to construction safety and health. It is for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402.

C. National Emission Standards of Hazardous Air Pollutants (40 CFR, Part 61).

D. Environmental Protection Agency (EPA) Final Rule (40 CFR Part 761) dated July 17, 1985.

1.4 DEFINITION OF HAZARDOUS MATERIALS

A. Refer to hazardous and toxic materials/substances included in Subparts H and Z of 29 CFR 1910; and to others as additionally defined in Fed. Std. 313. Those most commonly encountered include asbestos, polychlorinated biphenyls (PCB'S), explosives, and radioactive material, but may include others. The most likely products to contain asbestos are sprayed-on fireproofing, insulation, boiler lagging, pipe covering and likely products to contain PCB'S are transformers, capacitors, voltage regulators, and oil switches.

1.5 QUALITY ASSURANCE:

A. Safety Meeting: Representatives of the Contractor shall be prepared to discuss, in detail, the measures he/she intends to take in order to control any unsafe or unhealthy conditions associated with the work to be performed under the contract. If directed by the Owner, this meeting may be held in conjunction with other meetings which are scheduled to take place prior to start of work under this contract. The level of detail for the safety meeting is dependent upon the nature of the work and the potential inherent hazards. The Contractor's principal on-site representative(s), the general superintendent and his/her safety representative(s) shall attend this meeting.

B. Contractor Responsibility: The Contractor shall assume full responsibility and liability for compliance with all applicable regulations pertaining to the health and safety of personnel during the execution of work, and shall hold State of Colorado and its Consultants harmless for any action on his/her part or that of his/her employees or subcontractors, which results in illness, injury or death.

C. Compliance With Regulations for Hazardous Materials: All work, including contact with and handling of hazardous materials, the disturbance or dismantling of structures containing hazardous materials and/or the disposal of hazardous materials shall comply with the applicable requirements of 29 CFR 1926/1910 or 40 CFR 761. Work involving the disturbance, dismantling of asbestos or asbestos containing materials; the demolition of structures containing asbestos; and/or the disposal and removal of asbestos, shall also comply with the requirements of 40 CFR, Part 61, Subparts A and M. All work shall comply with applicable state and municipal safety and health requirements. Where there is a conflict between applicable regulations, the most stringent shall apply.

1.6 SUBMITTALS

A. Accident Reporting: A copy of each accident report, which the Contractor or subcontractors submit to their insurance carriers, shall be forwarded to the Owner's Representative as soon as possible, but in no event later than seven (7) calendar days after the day the accident occurred.

B. Permits: When hazardous materials (if any) are disposed of off site, submit copies of permits from applicable, Federal, state, or municipal authorities and necessary certificates that the material has been disposed of as per regulations.

C. Other Submittals: Provide a plan of action for handling work protection from the fall exposure, and protection of the public at the ground level. Submittal shall contain the following as a minimum.
1. Number, type, and experience of employees to be used for the work.
2. Description of how applicable safety and health regulations and standards are to be met.
3. Type of protective equipment and work procedures to be used.
4. Identification of possible hazards, problems, and proposed control mechanisms.
5. Protection of public or others not related to the operation.
6. Interfacing and control of subcontractors, if any.
7. Copy of the Contractor’s safety manual

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT:

A. Special facility, devices, equipment, clothing, and similar items used by the Contractor in the execution of work shall comply with the applicable regulations.

2.2 HAZARDOUS MATERIALS

A. The contractor shall bring to the attention of the Owner any material suspected of being hazardous which he/she encounters during execution of the work. A determination will be made by the Owner as to whether the Contractor shall perform tests to determine if the material is hazardous. If the Owner directs the Contractor to perform tests, and/or if the material is found hazardous and additional protective measures are needed, a contract change may be required, subject to applicable provisions of this contract.

PART 3 - EXECUTION

3.1 STOP WORK ORDERS

A. When the Contractor or his/her subcontractors are notified by the Owner's Representative(s) of any noncompliance with the provisions of the contract and the action(s) to be taken, the Contractor shall immediately, if directed, or within 48 hours after receipt of a notice of violation correct the unsafe or unhealthy condition. If the Contractor fails to comply promptly, all or any part of the work being performed may be stopped by the Owner or Owner's Representative with a "Stop Work Order". When, in the opinion of the Owner or Owner's Representative satisfactory corrective action has been taken to correct the unsafe and unhealthy condition, a start order will be given immediately. The Contractor shall not be allowed any extension of time or compensation for damages by reason of or in connection with such work stoppage.

3.2 PROTECTION

A. The Contractor shall take all necessary precautions to prevent injury to workers, the public, building occupants, or damage to property. For the purposes of this contract, the public or building occupants shall include all persons not employed by the Contractor or a subcontractor working under his/her direction.

B. Storing, positioning or use of equipment, tools, materials, scraps, and trash in a manner likely to present a hazard to the public or building occupants by its accidental shifting, ignition, or other hazardous qualities is prohibited.

C. Obstructions: No corridor, aisle, stairway, door of exit shall be obstructed or used in such a manner as to encroach upon routes of ingress or egress utilized by the public or building occupant, or to present unsafe or unhealthy conditions to the public or building occupant.

D. Work shall not be performed in any area occupied by the public or employees unless specifically permitted by the Contract or the Owner's Representative, and unless adequate stops are taken for the protection of the public or employees.

E. Alternate Precautions: When the nature of the work prevents isolation of the work area and the public or building occupants may be in or pass through, under or over the work area, alternate precautions such as the posting of signs, the use of signal personal, the erection of barricades or similar protection around particularly hazardous operations shall be used as appropriate.

F. Public Thoroughfare: When work is to be performed over a public thoroughfare such as a sidewalk, lobby, or corridor, the thoroughfare shall be closed, if possible, or other precautions taken such as the installation of screens or barricades. When the exposure to heavy falling objects exists, as during demolition, special protection of the type detailed in 29 CFR 1910/1926 shall be provided.

G. Fall Protection: The Contractor shall comply with OSHA regualtion 1926.500 in its entirety for the entire duration of this project. Any violation of these regulations shall cause the project to be shut down until full compliance is achieved. Repeated violations may result in termination of the Contract.

END OF SECTION 01 54 00

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SECTION 01 60 00 - MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements governing the Contractor's selection of products for use in the Project.

1.3 DEFINITIONS

A. Definitions used in this Article are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties," "systems," "structure," "finishes," "accessories," and similar terms. Such terms are self-explanatory and have well-recognized meanings in the construction industry.
   1. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
   2. "Named Products" are items identified by the manufacturer's product name, including make or model number or other designation, shown or listed in the manufacturer's published product literature, that is current as of the date of the Contract Documents.
   3. "Foreign Products," as distinguished from "domestic products," are items substantially manufactured (50 percent or more of value) outside the United States and its possessions. Products produced or supplied by entities substantially owned (more than 50 percent) by persons who are not citizens of, nor living within, the United States and its possessions are also considered to be foreign products.
   4. "Materials" are products substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.
   5. "Equipment" is a product with operational parts, whether motorized or manually operated, that requires service connections, such as wiring or piping.

1.4 QUALITY ASSURANCE

A. Source Limitations: To the fullest extent possible, provide products of the same kind from a single source.
   1. When specified products are available only from sources that do not, or cannot, produce a quantity adequate to complete project requirements in a timely manner, consult with the Owner’s Representative to determine the most important product qualities before proceeding.
   2. Qualities may include attributes, such as visual appearance, strength, durability, or compatibility. When a determination has been made, select products from sources producing products that possess these qualities, to the fullest extent possible.

B. Compatibility of Options: When the Contractor is given the option of selecting between 2 or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.

1. Each prime contractor is responsible for providing products and construction methods that are compatible with products and construction methods of other prime or separate contractors.
2. If a dispute arises between prime contractors over concurrently selectable, but incompatible products, the Owner's Representative will determine which products shall be retained and which are incompatible and must be replaced.

C. Foreign Product Limitations: Except under one or more of the following conditions, provide domestic products, not foreign products, for inclusion in the Work:
1. No available domestic product complies with the Contract Documents.
2. Domestic products that comply with the Contract Documents are available only at prices or terms substantially higher than foreign products that comply with the Contract Documents.

D. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products that will be exposed to view in occupied spaces or on the exterior.
1. Labels: Locate required product labels and stamps on concealed surfaces or, where required for observation after installation, on accessible surfaces that are not conspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on an easily accessible surface that is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:
   a. Name of product and manufacturer.
   b. Model and serial number.
   c. Capacity.
   d. Speed.
   e. Ratings.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft.
1. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to the site in an undamaged condition in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
5. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.
6. Store heavy materials away from the Project structure in a manner that will not endanger the supporting construction.
7. Store products subject to damage by the elements above ground, under cover in a weathertight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

1.6 SUBSTITUTIONS:

A. Basis: After execution of the Contract, the Owner's Representative will consider substitutions of products in place of those specified or approved only if the specified product or products, through no fault of the Contractor or his Subcontractors, cannot be delivered in time to meet the construction schedule or is no longer available.

B. Procedure: Make written request for the substitution documenting fully the above reason. Include complete data on the proposed substitution substantiating compliance with the Contract Documents including product identification and description, performance and test data, references and samples where applicable, and an itemized comparison of the proposed substitution with the products specified or otherwise approved, with data relating to Contract time schedule, design and artistic effect where applicable, and its relationship to separate contracts. Accompany the request by accurate installed cost data on the proposed substitution in comparison with the product specified.

C. Consideration: Making such requests for substitutions is a representation by the Contractor that:
   1. The Contractor has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified and will carry the same warranty;
   2. The cost data are complete and include all related costs under this Contract but excludes costs under separate contracts and excludes Design Consultant's re-design costs, and the Contractor waives all claims for additional costs related to the substitution which subsequently become apparent;
   3. The Contractor will coordinate the installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects.

D. When approved by the Owner's Representative, such substitution will be documented by Change Order modifying the Specifications. The Contract Sum will be changed only if the substitution results in a cost savings to the Owner.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, new at the time of installation.
   1. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and the intended use and effect.
   2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.

B. Product Selection Procedures: The Contract Documents and governing regulations govern product selection. Procedures governing product selection include the following:
   1. Proprietary Specification Requirements: Where Specifications name only a single product or manufacturer, provide the product indicated. No substitutions will be permitted.
   2. Semiproprietary Specification Requirements: Where Specifications name 2 or more products or manufacturers, provide 1 of the products indicated. No substitutions will be permitted.
      a. Where Specifications specify products or manufacturers by name, accompanied by the term "or equal" or "or approved equal," comply with the Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.

3. Nonproprietary Specifications: When Specifications list products or manufacturers that are available and may be incorporated in the Work, but do not restrict the Contractor to use of these products only, the Contractor may propose any available product that complies with Contract requirements. Comply with Contract Document provisions concerning "substitutions" to obtain approval for use of an unnamed product.
4. Descriptive Specification Requirements: Where Specifications describe a product or assembly, listing exact characteristics required, with or without use of a brand or trade name, provide a product or assembly that provides the characteristics and otherwise complies with Contract requirements.
5. Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products that comply with these requirements and are recommended by the manufacturer for the application indicated.
    a. Manufacturer's recommendations may be contained in published product literature or by the manufacturer's certification of performance.
6. Compliance with Standards, Codes, and Regulations: Where Specifications only require compliance with an imposed code, standard, or regulation, select a product that complies with the standards, codes, or regulations specified.
7. Visual Matching: Where Specifications require matching an established Sample, the Owner's Representative's decision will be final on whether a proposed product matches satisfactorily.
    a. Where no product available within the specified category matches satisfactorily and complies with other specified requirements, comply with provisions of the Contract Documents concerning "substitutions" for selection of a matching product in another product category.
8. Visual Selection: Where specified product requirements include the phrase "... as selected from manufacturer's standard colors, patterns, textures ..." or a similar phrase, select a product and manufacturer that complies with other specified requirements. The Owner's Representative will select the color, pattern, and texture from the product line selected.
9. Allowances: Refer to individual Specification Sections and "Allowance" provisions in Division 1 for allowances that control product selection and for procedures required for processing such selections.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS

A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other Work.
    1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION 01 60 00

SECTION 01 70 00 - PROJECT CLOSEOUT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for project closeout, including but not limited to:
   1. Inspection procedures.
   2. Project record document submittal.
   3. Operating and maintenance manual submittal.
   4. Submittal of warranties.
   5. Final cleaning.

1.3 PROJECT COMPLETION AND FINAL INSPECTION

A. The Contractor shall file a written notice with the Owner's Representative that the work in the opinion of the Contractor, is complete under the terms of the contract.

B. Within ten (10) days after the Contractor files written notice that the work is complete, the Owner's Representative, the District and the Contractor shall make a "final inspection" of the project to determine whether the work has been completed in accordance with the contract documents. A final punch list shall be made by the Owner's Representative in sufficient detail to fully outline to the Contractor.
   1. Work to be completed, if any;
   2. Work not in compliance with the drawings and specifications, if any;
   3. Unsatisfactory work for any reason, if any.

C. The required amount of copies of the punch list will be countersigned by the Owner's Representative and the District and will be transmitted by the Owner's Representative to the Contractor and the District.

1.4 ADVERTISEMENT AND FINAL PAYMENT

A. Prior to final payment to the Contractor, the Owner shall advertise the project as set forth in Article 50 of the General Conditions of the Contract.

B. Before the Principle Representative may advertise, the Contractor shall:
   1. Deliver to the Owner's Representative:
      a. Closing-out Checklist and Contractor Close-out forms with all items completed.
      b. Final pay request accounting for final additional changes to the Contract Sum, including deductions for uncorrected work and deductions for reinspection payments. The final pay request shall reflect a reduction of the retainage to zero. The final pay request amount shall show the total Contract Sum, as adjusted by change orders, previous payments, and the sum remaining due.
      c. All guaranties and warranties

d. All statements to support local sales tax refunds.
e. Three complete bound sets of required operating maintenance instructions and manuals.
f. One set of drawings showing all job changes (as-built drawings)

2. Complete start-up testing of systems, and demonstrate to the operating personnel of the Principal Representative proper operation and maintenance of all newly installed or refurbished equipment.
3. Deliver tools, spare parts, extra stock, and similar items.
4. Make final change-over of permanent locks and transmit keys to the Owner. Advise the Owner personnel of change-over in security provisions.
5. Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.
6. Complete final clean up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.

1.5 RECORD DOCUMENT SUBMITTALS

A. General: Do not use record documents for construction purposes; protect from deterioration and loss in a secure, fire-resistive location; provide access to record documents for the Owner's Representative's reference during normal working hours.

B. Record Drawings (as-built drawings): Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately; where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.
1. Mark record sets with erasable pencil; use other colors to distinguish between variations in separate categories of the Work. Define colors by color legend on front sheet.
2. Mark new information that is important to the District, but was not shown on Contract Drawings or Shop Drawings.
3. Note related Change Order numbers where applicable.
4. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.

C. Record Specifications: Maintain one complete copy of the Project Manual, including addenda, and one copy of other written construction documents such as Change Orders and modifications issued in printed form during construction. Mark these documents to show substantial variations in actual Work performed in comparison with the text of the Specifications and modifications. Give particular attention to substitutions, selection of options and similar information on elements that are concealed or cannot otherwise be readily discerned later by direct observation. Note related record drawing information and Product Data.

D. Maintenance Manuals: Organize operating and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual heavy-duty 2-inch, 3-ring vinyl-covered binders, with pocket folders for folded sheet information. Mark appropriate identification on front and spine of each binder. Include the following types of information:
1. Emergency instructions.
2. Spare parts list.
3. Copies of warranties.
4. Wiring diagrams.
5. Recommended "turn around" cycles.
6. Inspection procedures.
7. Shop Drawings and Product Data.
8. Fixture lamping schedule.

1.6 MISCELLANEOUS KEYS, SWITCHES, ETC.

A. At the completion of the project, all loose keys for hose bibs; adjustment keys and wrenches for door closers and panic hardware, and keys for electric switches, electrical panels, etc., shall be accounted for and turned over to the District.

1.7 WARRANTIES

A. The Contractor and each sub-contractor shall remedy any defects to faulty materials or workmanship and pay for any damage to other work resulting therefrom, which shall appear in his work within a period of one year from the date of Notice of Acceptance and in accordance with the terms of any special warranties provided in the contract. The Owner shall give notice of observed defects with reasonable promptness.

B. Upon completion of his work, the Contractor shall deliver to the Consultant in duplicate, a written warranty based on the provision of this Article properly signed and notarized. Warranty shall be addressed to the District.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 CLOSEOUT PROCEDURES

A. Operating and Maintenance Instructions: Arrange for each installer of equipment that requires regular maintenance to meet with the District's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following items:

1. Maintenance manuals.
2. Record documents.
3. Spare parts and materials.
4. Tools.
5. Lubricants.
6. Fuels.
7. Identification systems.
8. Control sequences.
9. Hazards.
10. Cleaning.
11. Warranties and bonds.
12. Maintenance agreements and similar continuing commitments.

B. As part of instruction for operating equipment, demonstrate the following procedures:
   1. Start-up.
   2. Shutdown.
   3. Emergency operations.
   4. Noise and vibration adjustments.
   5. Safety procedures.
   6. Economy and efficiency adjustments.
   7. Effective energy utilization.

3.2 FINAL CLEANING

A. General: General cleaning during construction is required by the General Conditions and included in Section "Temporary Facilities".

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.
   1. Complete the following cleaning operations before requesting final inspection:
      a. Remove labels that are not permanent labels.
      b. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
      c. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition. Leave concrete floors broom clean. Vacuum carpeted surfaces.
      d. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.
      e. Clean the site, including landscape development areas, of rubbish, litter and other foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake grounds that are neither paved nor planted, to a smooth even-textured surface.

C. Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction.

D. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the District's property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a lawful manner. Where extra materials of value remaining after completion of associated Work have become the District's property, arrange for disposition of these materials as directed.

END OF SECTION 01 70 00

SECTION 01 71 00 - CLEANING

PART 1 - GENERAL

1.1 CLEANING

A. Clean-up During Construction: Each contractor shall keep the building and premises free from all surplus material, waste material, dirt and rubbish caused by his employees or work, and at the completion of his work he shall remove all such surplus material, waste material, dirt and rubbish, as well as his tools, equipment and scaffolding, and shall leave his work clean and spotless, unless more exact requirements are specified. In case of dispute, the owner may remove all such items and charge the cost of such removal to the contractor.
   1. Each sub-contractor shall perform his clean-up daily and shall transport his rubbish to an on-site location designated by the Contractor who will arrange for its removal.
   2. Use of College dumpsters by the Contractor or his subcontractors is prohibited.

B. Cleaners: With the exception of clean-up of the site and cleaning specifically assigned to Contractors under various sections of the specifications, all final clean-up of exterior and interior of the building shall be done by professional cleaners.

C. Final Clean-up:
   1. Exterior: In addition to items specified below, any new surfaces on exterior, concrete, metal, etc. shall be carefully and thoroughly cleaned.
   2. Glass: Both sides of all glass in work areas shall be carefully and thoroughly cleaned by professional window cleaners and left absolutely clean and free from paint, grease, dirt, etc.
   3. Hardware: Clean and polish all hardware and leave clean and free from paint, grease, dirt, etc.
   4. Plumbing: Clean and polish all plumbing fixtures, fittings, and exposed plated piping. Leave clean and free from paint, grease, dirt, etc. Remove all labels.
   5. Electrical: Clean and polish all electric fixtures, including glassware, switchplates, etc., and leave clean and free from paint, grease, dirt, etc.
   6. Equipment: Carefully and thoroughly clean all items of equipment, mechanical, electrical, cabinets, ductwork, etc.
   7. Floors: Thoroughly clean all floors. Mop resilient floor coverings with warm water and mild detergent as recommended by manufacturer of the tile, then thoroughly machine buff. Vacuum and clean carpeting. Damp mop or scrub concrete floors as required to leave them thoroughly clean when site or building is turned over to the District.

D. Completion: The entire work inside and out, and the entire premises shall be in first-class, clean condition upon completion before being accepted by the Owner and the District.

END OF SECTION 01 71 00

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SECTION 01 74 00 - WARRANTIES AND BONDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

A. Section Includes: General administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.

B. Related Sections:
1. Refer to the General Conditions for terms of the Contractor's special warranty of workmanship and materials.
2. General closeout requirements: Section 01700
3. Specific requirements for warranties for Work, products and installations: Individual Sections of Divisions-2 through -16
4. Certifications and other commitments and agreements for continuing services to Owner: Applicable portions of Contract Documents.

C. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and Subcontractors required to countersign special warranties with the Contractor.

1.3 DEFINITIONS:

A. Standard Product Warranties: Preprinted written warranties published by individual manufacturers for particular products and specifically endorsed by the manufacturer to the District.

B. Special Warranties: Written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the District.

1.4 GENERAL WARRANTY REQUIREMENTS:

A. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by re-placement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the District has benefited from use of the Work through a portion of its anticipated useful service life.

D. District's Recourse: Written warranties made to the District are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the District can enforce such other duties, obligations, rights, or remedies.

E. Rejection of Warranties: The District reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

F. The District reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

1.5 SUBMITTALS:

A. Submit written warranties to the Owner prior to advertisement of the Notice of Contractor's Settlement. If the Notice of Acceptance designates a commencement date for warranties other than the date of Notice of Acceptance for the Work, or a designated portion of the Work, submit written warranties upon request of the Owner.

B. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Owner within 15 days of completion of that designated portion of the Work.

C. When a special warranty is required to be executed by the Contractor, or the Contractor and a Subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the OWNER through the Owner’s Representative for approval prior to final execution.

D. Refer to individual Sections of Divisions 2 through 16 for specific content requirements, and particular requirements for submittal of special warranties.

E. Form of Submittal:

1. Prior to advertisement of Notice of Contractor's Settlement, compile 2 copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, Subcontractor, supplier or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.
2. Bind warranties and bonds in heavy duty, commercial quality, durable 3-ring vinyl covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8.5" by 11" paper.
3. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address and telephone number of the Installer.
4. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS", the Project title or name, and the name of the Contractor.
5. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

PART 2 - PRODUCTS (Not applicable)

PART 3 - EXECUTION (Not applicable)

END OF SECTION 01 74 00

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SECTION 01 78 00 - DEFINITIONS AND EXPLANATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Specification sections, apply to work of this section.

1.2 SUMMARY:

A. Section Includes: Definitions of certain terms used in the specifications, and explanations of the language, abbreviations thereof, format and certain conventions used in the specifications and associated Contract Documents.

B. Limitations of Scope: The definitions and explanations of this section are not necessarily either complete or exclusive, but are general for the work to the extent such definitions or explanations are not stated more explicitly in other provisions of the Contract Documents.

1.3 DEFINITIONS:

A. The term “Owner” shall mean Arriba Flagler Consolidated School District 20.

B. Project Manual: The term "Project Manual" refers to a bound, printed volume or volumes, which includes conditions of the Contract and the Specifications. It may also include bidding requirements, contract forms, details, schedules, surveys, reports or other relevant items which may or may not be Contract Documents.

C. General Requirements: Provisions and requirements of other Division 1 Sections apply to the entire work of the Contract and, where so indicated, to other elements of work which are included in the Project.

D. Indicated: The term "indicated" is a cross reference to graphic representations, notes or schedules on the drawings, to other paragraphs or schedules in the specifications, and to similar means of recording requirements in the Contract Documents. Where terms such as "shown", "noted", "scheduled" and "specified" are used in lieu of "indicated", it is for the purpose of helping the reader accomplish the cross reference, and no limitation is intended except as specifically noted.

E. Directed, Requested, etc.: Terms such as "directed", "requested", "authorized", "selected", "approved", "required", "accepted", and "permitted" mean "directed by the Owner’s Representative", "requested by the Owner’s Representative", etc. However, no such implied meaning will be interpreted to extend the Owner’s Representative responsibility into the Contractor's area of construction supervision.

F. Installer: The entity (person or firm) engaged by the Contractor or his Subcontractor or Sub-subcontractor for the performance of a particular element of construction at the project site, including installation, erection, application and similar required operations. It is a general requirement that Installers be expert in the operations they are engaged to perform.

G. The term "experienced", when used with the term "Installer" means having completed a minimum of 5 successful previous projects similar in size and scope to this Project and means the Installer is familiar with the precautions required and has complied with requirements of the authorities having jurisdiction.

H. Where the specifications require Installer experience or other qualifications, such requirements apply to the firm and not to its employees or individual members. Where firm ownership has changed after the required experience occurred, the Owner reserve the right to consider the ownership change as invalidating the experience requirements.

I. Project Site: The space available to the Contractor for the performance of the Work, either exclusively or in conjunction with others performing other work as part of the project. The extent of the project site is shown on the drawings, and may or may not be identical with the description of the land upon which the project is to be built.

J. Testing Laboratory or Agency: An independent entity engaged to perform specific inspections or tests of the work, either at the project site or elsewhere; and to report and (if required) interpret the results of those inspections or tests.

K. Approve: Where used in conjunction with the Owner’s Representative action on the Contractor's submittals, applications and requests, is limited to the Owner’s Representative responsibilities and duties as specified in the General and Supplementary Conditions. Such approval shall not release the Contractor from responsibility to fulfill requirements of the Contract Documents, unless otherwise provided in the Contract Documents.

L. Regulation: The term "Regulations" includes laws, statutes, ordinances 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, whether they are lawfully imposed by authorities having jurisdiction or not.

M. Contractor's Option: Where materials, products, systems or methods are specified to be at the Contractor's option, the choice of which material, method, product or system will be used is solely the Contractor's. There will be no change in Contract Sum or Time because of such choice.

N. Furnish: The term "furnish" is used to mean, "supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, and similar operations".

O. Install: The term "install" is used to describe operations at the project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations".

P. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use".

Q. Guarantee: The narrow definition of the term "warranty" is hereby established as applying to both "warranty" and "guarantee" which terms are used interchangeably.

1.4 SPECIFICATION EXPLANATIONS:

A. General: This article is provided to help the user of these specifications to more readily understand the format, language, implied requirements and similar conventions of content. None of these explanations will be interpreted to modify the substance of the requirements.

B. Specification Format: These specifications are organized and based on the CSI 16-Division format, including subdivision of the Divisions into Sections generally conforming to CSI "Masterformat" for section titles and numbers.

C. Imperative Language: Imperative language is used generally in the specifications. Requirements expressed imperatively are to be performed by the Contractor. At certain locations in the text, for clarity,

contrasting subjective language is used to describe the responsibilities which must be fulfilled either indirectly by the Contractor or, when so noted, by others.

1.5 SPECIFICATION CONTENT CONVENTIONS:

A. Overlapping Requirements: Where compliance with two or more industry standards or sets of requirements is specified, and overlapping of those requirements also establishes different or conflicting minimums or levels of quality, the more stringent requirement will be enforced unless the Contract Documents specifically indicate otherwise.

B. Refer apparently equal but different requirements and uncertainties as to which level of quality is required to the Owner’s Representative for decision before proceeding.

C. In certain circumstances language used in specifications and other Contract Documents is of the abbreviated type. Implied words and meanings will be appropriately interpreted. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where the full context of the Contract Documents so indicates.

D. Specialists: In certain circumstances the specification requires or implies that specific elements of the Work be assigned to specialists or expert entities who must be engaged to perform that element of the work. Such assignments are special requirements over which the Contractor has no choice or option. They are intended to establish which party or entity involved in a specific element of the Work is considered as being sufficiently experienced in the indicated construction processes or operations to be recognized as "expert" in those processes or operations. Nevertheless, the ultimate responsibility for fulfilling all contract requirements remains with the Contractor.

E. These requirements should not be interpreted to conflict with the enforcement of the building codes and similar regulations governing the Work. They are also not intended to interfere with local trade union jurisdictional settlements and similar conventions.

F. Trades: The use of certain titles such as "carpentry" in the specification is not intended to imply that the work must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter". It also is not intended to imply that the requirements specified apply exclusively to tradepersons of that corresponding generic name.

1.6 DRAWING SYMBOLS:

A. Graphic symbols used on the Drawings are those recognized in the construction industry for purposes indicated. Where not otherwise noted, symbols are defined by "Architectural Graphic Standards", published by John Wiley & Sons, Inc., seventh edition.

B. Mechanical/Electrical Drawings: Graphic symbols used on mechanical and electrical Drawings are generally aligned with symbols recommended by ASHRAE. Where appropriate, they are supplemented by more specific symbols recommended by technical associations including ASME, ASPE, IEEE and similar organizations. Refer instances of uncertainty to the Owner's Representative for clarification before proceeding.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01 78 00

SECTION 04 20 00 - UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes unit masonry assemblies consisting of the following:

1. Concrete masonry units (CMUs).
2. Face brick.
3. Building (common) brick.
4. Steel lintels.

1.2 SUBMITTALS

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

B. Samples for each type and color of exposed masonry units.

1.3 PROJECT CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 COLORS, TEXTURES, AND PATTERNS

A. Exposed Masonry Units: Match existing.

2.3 CONCRETE MASONRY UNITS (CMUs)

A. Shapes: Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

B. Concrete Masonry Units: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi (13.1 MPa).
2. Weight Classification: Normal weight.

2.4 BRICK

A. Face Brick: ASTM C 216, Grade MW or SW, Type FBS.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3000 psi (20.7 MPa).
2. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67.
3. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
4. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet (3 m).
5. Size (Actual Dimensions): Match existing.

2.5 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction.

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

C. Masonry Cement: ASTM C 91.

1. Available Products:

a. Holcim (US) Inc.; Mortamix Masonry Cement.
b. Lafarge North America Inc.; Lafarge Masonry Cement.
c. Lehigh Cement Company; Lehigh Masonry Cement.

D. Mortar Pigments: Iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.

1. Products:

a. Bayer Corporation, Industrial Chemicals Div.; Bayferrox Iron Oxide Pigments.
b. Davis Colors; True Tone Mortar Colors.
c. Solomon Grind-Chem Services, Inc.; SGS Mortar Colors.

E. Aggregate for Mortar: ASTM C 144.

1. For joints less than 1/4 inch (6.5 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.

F. Aggregate for Grout: ASTM C 404.

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

1. Available Products:

a. Addiment Incorporated; Mortar Kick.
b. Euclid Chemical Company (The); Accelguard 80.
c. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Morset.
d. Sonneborn, Div. of ChemRex; Trimix-NCA.

H. Water: Potable.

2.6 REINFORCEMENT

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

B. Masonry Joint Reinforcement: ASTM A 951; mill galvanized, carbon-steel wire for interior walls and hot-dip galvanized, carbon-steel wire for exterior walls.

1. Wire Size for Side Rods: W1.7 or 0.148-inch (3.8-mm) diameter.
2. Wire Size for Cross Rods: W1.7 or 0.148-inch (3.8-mm) diameter.
3. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (407 mm) o.c.
4. Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.
5. Multiwythe Masonry:

a. Ladder type with 1 side rod at each face shell of hollow masonry units more than 4 inches (100 mm) in width, plus 1 side rod at each wythe of masonry 4 inches (100 mm) or less in width.
b. Tab type, with 1 side rod at each face shell of backing wythe and with rectangular tabs sized to extend at least halfway through facing wythe but with at least 5/8-inch (16-mm) cover on outside face.
c. Adjustable (two-piece) type, with one side rod at each face shell of backing wythe and with ties that extend into facing wythe. Ties engage eyes or slots in reinforcement and extend at least halfway through facing wythe but with at least 5/8-inch (16-mm) cover on outside face. Ties have hooks or clips to engage a continuous wire in the facing wythe.

2.7 STEEL LINTELS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces without blemishes.

B. Loose Steel Lintels: Fabricate loose steel lintels from steel angles and shapes of size indicated and conforming to ASTM A 36/A 36M for openings and recesses in masonry walls and partitions at locations indicated.

1. Lintels in Exterior Walls: Prime with zinc-rich primer.

2.8 MASONRY CLEANERS

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

1. Manufacturers:

a. Diedrich Technologies, Inc.
b. EaCo Chem, Inc.
c. ProSoCo, Inc.

2.9 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, unless otherwise indicated.

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

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

1. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
2. For interior non-load-bearing partitions, Type O may be used instead of Type N.

C. Pigmented Mortar: If required to match existing mortar, select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products].

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Pigments shall not exceed 5 percent of masonry cement by weight.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

C. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

D. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:

1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.

3.2 LAYING MASONRY WALLS

A. Bond Pattern for Exposed Masonry: Match existing bond. Tooth in units to utilize full size units at infill.

3.3 MORTAR BEDDING AND JOINTING

A. Lay hollow brick and concrete masonry units as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints to match existing adjacent joints.

3.4 COMPOSITE MASONRY

A. Bond wythes of composite masonry together using one of the following methods:

1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 4.5 sq. ft. (0.42 sq. m) of wall area spaced not to exceed 24 inches (610 mm) o.c. horizontally and 16 inches (406 mm) o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches (305 mm) of openings and space not more than 36 inches (915 mm) apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches (610 mm) o.c. vertically.
2. Masonry Joint Reinforcement: Installed in horizontal mortar joints.

    a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both withes or tab-type reinforcement.
    b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties.

B. Collar Joints: Solidly fill collar joints by parging face of first wythe that is laid and shoving units of other wythe into place.

3.5 MASONRY JOINT REINFORCEMENT

A. General: Install in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).

3.6 CLEANING

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

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
2. Protect adjacent surfaces from contact with cleaner.
3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
4. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

END OF SECTION 042000

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Exterior non-load-bearing wall framing.

B. Related Sections include the following:

1. Division 09 Section "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.3 SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:

1. Allied Studco.
2. AllSteel Products, Inc.
3. Clark Steel Framing.

4. Consolidated Fabricators Corp.; Building Products Division.
5. Craco Metals Manufacturing, LLC.
6. Custom Stud, Inc.
7. Dale/Incor.
8. Design Shapes in Steel.
9. Dietrich Metal Framing; a Worthington Industries Company.
10. Formetal Co. Inc. (The).
11. Innovative Steel Systems.
12. MarinoWare; a division of Ware Industries.
13. Quail Run Building Materials, Inc.
14. SCAFCO Corporation.
15. Steel Construction Systems.
16. Steeler, Inc.
17. Super Stud Building Products, Inc.
18. United Metal Products, Inc.

2.2 MATERIALS

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: As required by structural performance.
2. Coating: G60 (Z180), A60 (ZF180), AZ50 (AZ150), or GF30 (ZGF90).

2.3 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm).
2. Flange Width: 1-5/8 inches (41 mm).

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm).
2. Flange Width: 1-1/4 inches (32 mm).

2.4 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.

3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers, knee braces, and girts.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

2.5 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

C. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

D. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

E. Welding Electrodes: Comply with AWS standards.

2.6 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A 780.

2.7 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

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

3.2 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).

D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

H. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.3 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:

1. Stud Spacing: 16 inches (406 mm).

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.4 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 06 10 53 - MISCELLANEOUS CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Wood blocking.
2. Exterior siding panels
3. Interior wood trim.

1.2 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1. Preservative-treated wood.
2. Power-driven fasteners.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Provide dressed lumber, S4S, unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA C2, except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2.3 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.

B. For items of dimension lumber size, provide Standard, Stud, or No. 3 grade lumber with 19 percent maximum moisture content of any species.

C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine, No. 3 grade; SPIB.
2. Eastern softwoods, No. 3 Common grade; NELMA.
3. Northern species, No. 3 Common grade; NLGA.
4. Western woods, Standard or No. 3 Common grade; WCLIB or WWPA.

2.4 INTERIOR WOOD TRIM

A. General: Provide kiln-dried finished (surfaced) material without finger-jointing, unless otherwise indicated.

B. Lumber Trim for Opaque (Painted) Finish: Solid lumber, of one of the following species and grades:

1. Grade D Select eastern white pine; NeLMA or NLGA.
2. Grade D Select (Quality) Idaho white, lodgepole, ponderosa, or sugar pine; NLGA or WWPA.
3. Grade B Finish aspen, basswood, cottonwood, gum, magnolia, red alder, soft maple, sycamore, tupelo, or yellow poplar; NHLA.

2.5 SHEATHING

A. Plywood Wall Sheathing: Exterior, Structural I sheathing.

2.6 FIBER-CEMENT SIDING

A. General: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corp.
b. GAF Materials Corporation.
c. James Hardie.
d. Nichiha Fiber Cement.

2. Panel Texture: 48-inch- (1200-mm-) wide sheets with smooth texture.
3. Factory Priming: Manufacturer's standard acrylic primer.

2.7 FASTENERS

A. General: Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Power-Driven Fasteners: NES NER-272.

C. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. General: Comply with applicable recommendations in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial."

B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

C. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

D. Comply with fiber-cement panel manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

1. Do not install damaged components.

E. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

3. Wall and Roof Sheathing:

a. Screw to cold-formed metal framing.

F. Wood Trim Installation: Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Cope at returns and miter at corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints.

1. Install trim after gypsum board joint-finishing operations are completed.
2. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.6-mm) maximum offset for reveal installation.

G. Install fiber-cement panels and related accessories.

1. Install fasteners no more than 24 inches (600 mm) o.c.

H. Install joint sealants as specified in Division 07 Section "Joint Sealants" and to produce a weathertight installation.

3.2 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 53

SECTION 07 52 13 - ATACTIC-POLYPROPYLENE (APP) MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes APP-modified bituminous membrane roofing.

1.2 DEFINITIONS

A. Hot Roofing Asphalt: Roofing asphalt heated to its equiviscous temperature, the temperature at which its viscosity is 125 centipoise for mop-applied roofing asphalt and 75 centipoise for mechanical spreader-applied roofing asphalt, within a range of plus or minus 25 deg F (14 deg C), measured at the mop cart or mechanical spreader immediately before application.

1.3 SUBMITTALS

A. Product Data: For each product indicated.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer, approved by manufacturer to install manufacturer's products.

B. Source Limitations: Obtain components for roofing system from or approved by roofing system manufacturer.

C. Fire-Test-Response Characteristics: Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Exterior Fire-Test Exposure: Class C; ASTM E 108, for application and roof slopes indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. APP-Modified Bituminous Membrane Roofing:

a. CertainTeed Corporation.
b. Firestone Building Products Company.
c. GAF Materials Corporation.
d. Garland Co., Inc. (The).
e. Johns Manville International, Inc.
f. Koppers Industries, Inc.
g. U.S. Intec, Inc.

2.2 APP-MODIFIED ASPHALT-SHEET MATERIALS

A. Roofing Membrane Sheet: ASTM D 6222, Grade S, Type I or II, polyester-reinforced, APP-modified asphalt sheet; smooth surfaced; suitable for application method specified.

B. Roofing Membrane Cap Sheet: ASTM D 6222, Grade G, Type I or II, polyester-reinforced, APP-modified asphalt sheet; granular surfaced; suitable for application method specified, and as follows:

1. Granule Color: Gray.

2.3 BASE-SHEET MATERIALS

A. Sheathing Paper: Red-rosin type, minimum 3 lb/100 sq. ft. (0.16 kg/sq. m).

B. Base Sheet: ASTM D 4601, Type I, nonperforated, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.

2.4 BASE FLASHING SHEET MATERIALS

A. Backer Sheet: ASTM D 4601, Type I, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.

B. Flashing Sheet: ASTM D 6222, Grade G, Type I or II, polyester-reinforced, APP-modified asphalt sheet; granular surfaced; suitable for application method specified, and as follows:

1. Granule Color: Gray.

2.5 AUXILIARY ROOFING MEMBRANE MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing membrane.

B. Asphalt Primer: ASTM D 41.

C. Roofing Asphalt: ASTM D 312, Type III or IV as recommended by roofing system manufacturer for application.

D. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required by roofing system manufacturer for application.

E. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roofing membrane components to substrate, tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.

2.6 ROOF INSULATION

A. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, felt or glass-fiber mat facer on both major surfaces.

2.7 INSULATION ACCESSORIES

A. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

B. Insulation Cant Strips: ASTM C 728, perlite insulation board.

C. Wood Nailer Strips: Comply with requirements in Division 06 "Miscellaneous Carpentry."

D. Tapered Edge Strips: ASTM C 728, perlite insulation board.

PART 3 - EXECUTION

3.1 INSULATION INSTALLATION

A. Comply with roofing system manufacturer's written instructions for installing roof insulation.

B. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing membrane system with vertical surfaces or angle changes greater than 45 degrees.

C. Install one or more layers of insulation under area of roofing to match existing insulation. Where overall insulation thickness is 1-1/2 inches (38 mm) or greater, install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.

D. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.

E. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:

1. Prime surface of concrete deck with asphalt primer at a rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m) and allow primer to dry.
2. Set each layer of insulation in a solid mopping of hot roofing asphalt.

F. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.

3.2 ROOFING MEMBRANE INSTALLATION

A. Install roofing membrane system according to roofing system manufacturer's written instructions and applicable recommendations of ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."

B. Coordinate installing roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.

C. Substrate-Joint Penetrations: Prevent roofing asphalt from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

D. Loosely lay one course of sheathing paper, lapping edges and ends a minimum of 2 inches (50 mm) and 6 inches (150 mm), respectively.

E. Install one lapped course of base sheet, extending sheet over and terminating beyond cants. Attach base sheet as follows:

1. Adhere to substrate in a solid mopping of hot roofing asphalt.

F. Install modified bituminous roofing membrane sheet and cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system. Extend roofing membrane sheets over and terminate beyond cants, installing as follows:

1. Torch apply to substrate.
2. Unroll roofing membrane sheets and allow them to relax for minimum time period required by manufacturer.

G. Laps: Accurately align roofing membrane sheets, without stretching, and maintain uniform side and end laps. Stagger end laps. Completely bond and seal laps, leaving no voids.

1. Repair tears and voids in laps and lapped seams not completely sealed.

H. Install roofing membrane sheets so side and end laps shed water.

3.3 FLASHING AND STRIPPING INSTALLATION

A. Install base flashing over cant strips and other sloping and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrates according to roofing system manufacturer's written instructions.

B. Extend base flashing up walls or parapets a minimum of 8 inches (200 mm) above roofing membrane and 4 inches (100 mm) onto field of roofing membrane.

C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.

D. Install roofing membrane cap-sheet stripping where metal flanges and edgings are set on membrane roofing according to roofing system manufacturer's written instructions.

END OF SECTION 07 52 13

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SECTION 075323 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flashing of new penetrations in existing adhered EPDM membrane roofing system.

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is authorized to perform work on existing warranted system preserving the manufacturer’s warranty.

B. Source Limitations: Obtain components including for membrane roofing system from same manufacturer as existing system.

1.4 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.5 WARRANTY

A. All work to be in accordance with the manufacturer’s receommdations and standard deateils to preserve the existing Warranty without exception.

PART 2 - PRODUCTS

2.1 EPDM MEMBRANE ROOFING

A. EPDM: ASTM D 4637, Type I, non-reinforced, uniform, flexible EPDM sheet.

1. Manufacturers: Match existing manufacturer’s products.

2. Thickness: Match existing.
3. Exposed Face Color: Black.

2.2 AUXILIARY MEMBRANE ROOFING MATERIALS

A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.

B. Sheet Flashing: 60-mil- (1.5-mm-) thick EPDM, partially cured or cured, according to application.

C. Bonding Adhesive: Manufacturer's standard.

D. Seaming Material: Single-component, butyl splicing adhesive and splice cleaner or manufacturer's standard, synthetic-rubber polymer primer and 3-inch- (75-mm-) wide minimum, butyl splice tape with release film.

E. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to roofing system manufacturer.

F. Miscellaneous Accessories: Provide lap sealant, water cutoff mastic, metal termination bars, metal battens, pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

PART 3 - EXECUTION

3.1 ADHERED MEMBRANE ROOFING INSTALLATION

A. Adhere membrane roofing over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll membrane roofing and allow to relax before installing.

B. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

C. Bonding Adhesive: Apply to substrate and underside of membrane roofing at rate required by manufacturer and allow to partially dry before installing membrane roofing. Do not apply to splice area of membrane roofing.

D. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeters.

E. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of membrane roofing terminations.

F. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of membrane roofing terminations.

G. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.

3.2 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings.

3.3 FIELD QUALITY CONTROL

A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.

B. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.

END OF SECTION 075323

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SECTION 07 72 00 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Roof curbs.

1.2 SUBMITTALS

A. Product Data: For each type of roof accessory indicated.

B. Shop Drawings: Show fabrication and installation details for roof accessories.

1.3 QUALITY ASSURANCE

A. Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed in other Part 2 articles.

2.2 METAL MATERIALS

A. Galvanized Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coated and mill phosphatized for field painting.

B. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, AZ50 (AZM150) coated.

2.3 ROOF CURBS

A. Roof Curbs: Provide metal roof curbs, internally reinforced and capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported on roof curbs. Fabricate with welded or sealed mechanical corner joints, with integral metal cant and integral formed mounting flange at perimeter bottom. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1. Manufacturers:

    a. Colony Custom Curbs.
    b. Curbs Plus Inc.
    c. Custom Curb, Inc.
    d. LM Curbs.
    e. Loren Cook Company.
    f. Pate Company (The).
    g. Thaler Metal Industries Ltd.
    h. ThyCurb; Div. of Thybar Corporation.
    i. Uni-Curb, Inc.
    j. Vent Products Company, Inc.

2. Material: Galvanized or Aluminum-zinc alloy-coated steel sheet thick.

    a. Finish: Prime painted.

3. Liner: Same material as curb, of manufacturer's standard thickness and finish.
4. Factory install wood nailers at tops of curbs.
5. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
6. Factory insulate curbs with 1-1/2-inch- (38-mm-) thick, glass-fiber board insulation.
7. Curb height may be determined by adding thickness of roof insulation and minimum base flashing height recommended by roofing membrane manufacturer. Fabricate units to minimum height of 12 inches (300 mm), unless otherwise indicated.
8. Sloping Roofs: Where slope of roof deck exceeds 1:48, fabricate curb units with water diverter or cricket and with height tapered to match slope to level tops of units.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions. Anchor roof accessories securely in place and capable of resisting forces specified. Use fasteners, separators, sealants, and other miscellaneous items as required for completing roof accessory installation. Install roof accessories to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Install roof accessories to fit substrates and to result in watertight performance.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

    1. Underlayment: Where installing exposed-to-view components of roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene underlayment.
    2. Bed flanges in thick coat of asphalt roofing cement where required by roof accessory manufacturers for waterproof performance.

D. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.

END OF SECTION 07 72 00

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SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes joint sealants for the following applications, including those specified by reference to this Section:

1. Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
2. Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1.2 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Suitability for Immersion in Liquids. Where elastomeric sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247 and qualify for the length of exposure indicated by reference to ASTM C 920 for Class 1 or 2. Liquid used for testing sealants is deionized water, unless otherwise indicated.

D. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

E. Multicomponent Nonsag Urethane Sealant:

1. Products:

    a. Sika Corporation, Inc.; Sikaflex - 2c NS.
    b. Sonneborn, Division of ChemRex Inc.; NP 2.
    c. Tremco; Dymeric 240.
    d. Tremco; Dymeric 240 FC.

2. Type and Grade: M (multicomponent) and NS (nonsag).
3. Class: 25.

2.4 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), O (open-cell material), B (bicellular material with a surface skin), or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.5 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants.

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant.

    a. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.

2. Remove laitance and form-release agents from concrete.

    a. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 INSTALLATION

A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

B. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

F. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.3 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application JS-1: Exterior joints in vertical and horizontal nontraffic surfaces.

1. Joint Sealant: Multicomponent nonsag urethane sealant.

END OF SECTION 07 92 00

SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Interior gypsum board.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 INTERIOR GYPSUM BOARD

A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Gypsum Co.
b. BPB America Inc.
c. G-P Gypsum.
d. Lafarge North America Inc.
e. National Gypsum Company.
f. PABCO Gypsum.
g. Temple.
h. USG Corporation.

B. Regular Type:

1. Thickness: 1/2 inch (12.7 mm).
2. Long Edges: Tapered.

C. Type X:

1. Thickness: 5/8 inch (15.9 mm).
2. Long Edges: Tapered.

D. Ceiling Type: Manufactured to have more sag resistance than regular-type gypsum board.

1. Thickness: 1/2 inch (12.7 mm).

2. Long Edges: Tapered.

2.2 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:

a. Cornerbead.
b. L-Bead: L-shaped; exposed long flange receives joint compound.

2.3 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

D. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members, or provide control joints to counteract wood shrinkage.

3.2 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Regular Type: Vertical surfaces, unless otherwise indicated.
2. Type X: As indicated on Drawings.
3. Ceiling Type: Ceiling surfaces.

3.3 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners, unless otherwise indicated.
2. L-Bead: Use where indicated.

3.4 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for acoustical tile.
3. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.

a. Primer and its application to surfaces are specified in other Division 09 Sections.

3.5 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 29 00

SECTION 09 91 13 - PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes surface preparation and the application of paint systems on the following substrates:

1. Concrete masonry units (CMU).
2. Steel.
3. Galvanized metal.
4. Wood.
5. Exterior fiber cement board.
6. Gypsum board.

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

PART 2 - PRODUCTS

2.1 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Colors: As selected by Architect from manufacturer's full range.

2.2 BLOCK FILLERS

A. Interior/Exterior Latex Block Filler: MPI #4.

2.3 PRIMERS/SEALERS

A. Interior Latex Primer/Sealer: MPI #50.

B. Interior Alkyd Primer/Sealer: MPI #45.

2.4 METAL PRIMERS

A. Alkyd Anticorrosive Metal Primer: MPI #79.

B. Quick-Drying Alkyd Metal Primer: MPI #76.

C. Cementitious Galvanized-Metal Primer: MPI #26.

2.5 WOOD PRIMERS

A. Interior Latex-Based Wood Primer: MPI #39.

2.6 EXTERIOR LATEX PAINTS

A. Exterior Latex (Semigloss): MPI #11 (Gloss Level 5).

2.7 EXTERIOR ALKYD PAINTS

A. Exterior Alkyd Enamel (Semigloss): MPI #94 (Gloss Level 5).

2.8 LATEX PAINTS

A. Interior Latex (Eggshell): MPI #52 (Gloss Level 3).

B. Interior Latex (Semigloss): MPI #54 (Gloss Level 5).

C. High-Performance Architectural Latex (Eggshell): MPI #139 (Gloss Level 3).

D. High-Performance Architectural Latex (Semigloss): MPI #141 (Gloss Level 5).

2.9 ALKYD PAINTS

A. Interior Alkyd (Eggshell): MPI #51 (Gloss Level 3).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (Clay and CMU): 12 percent.
3. Wood: 15 percent.
4. Plaster: 12 percent.
5. Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION AND APPLICATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

D. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

E. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.3 EXTERIOR PAINTING SCHEDULE

A. Steel Substrates:

1. Alkyd System: MPI EXT 5.1D.

a. Prime Coat: Alkyd anticorrosive metal primer.
b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
c. Topcoat: Exterior alkyd enamel (semigloss).

B. Galvanized-Metal Substrates:

1. Alkyd System: MPI EXT 5.3B.

a. Prime Coat: Cementitious galvanized-metal primer.
b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
c. Topcoat: Exterior alkyd enamel (semigloss).

C. Exterior Fiber Cement Board Substrates:

1. Latex System: MPI EXT 9.2A.

a. Prime Coat: Exterior latex matching topcoat.
b. Intermediate Coat: Exterior latex matching topcoat.
c. Topcoat: Exterior latex (flat).

3.4 INTERIOR PAINTING SCHEDULE

A. CMU Substrates:

1. High-Performance Architectural Latex System: MPI INT 4.2D.

a. Prime Coat: Interior/exterior latex block filler.
b. Intermediate Coat: High-performance architectural latex matching topcoat.
c. Topcoat: High-performance architectural latex (eggshell).

B. Steel Substrates:

1. Alkyd System: MPI INT 5.1E.

a. Prime Coat: Quick-drying alkyd metal primer.
b. Intermediate Coat: Interior alkyd matching topcoat.
c. Topcoat: Interior alkyd (eggshell).

C. Dressed Lumber Substrates: Including wood trim.

1. Latex System: MPI INT 6.3T.

a. Prime Coat: Interior latex-based wood primer.
b. Intermediate Coat: Interior latex matching topcoat.
c. Topcoat: Interior latex (semigloss).

D. Gypsum Board Substrates:

1. Latex System: MPI INT 9.2A.

a. Prime Coat: Interior latex primer/sealer.
b. Intermediate Coat: Interior latex matching topcoat.
c. Topcoat: Interior latex (eggshell) or match existing adjacent finishes.

E. Gypsum Board Substrates at Locker Rooms:

1. High-Performance Architectural Latex System: MPI INT 9.2B.

a. Prime Coat: Interior latex primer/sealer.
b. Intermediate Coat: High-performance architectural latex matching topcoat.
c. Topcoat: High-performance architectural latex (semigloss).

END OF SECTION 099113

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SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section describes basic materials and methods that may be common to two or more sections of Division 23.

1.2 SUMMARY

A. This Section includes the following basic mechanical materials and methods.
   1. Piping hangers and supports
   2. Beam Clamps
   3. Electrical equipment
   4. Identification and labels
   5. Fire Stop Materials

1.3 SCOPE

A. The work covered by this Division of the Project Specifications consists of furnishing all labor, supervision, equipment, materials, incidentals, and appurtenances, and performing all operations as necessary to complete the installation of Division 23 work in strict accordance with this Division of the Project Specifications and as indicated on the Project Drawings.

1.4 RELATED WORK SPECIFIED ELSEWHERE

A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are a part of these Specifications and shall be used in conjunction with this Division as a part of the Contract Documents. Consult them for further instructions pertaining to this work. Contractors shall be responsible for and be governed by all requirements thereunder.

B. Related Sections:

1.	Common Work Results for HVAC Systems	Section 23 05 00
2.	Valves and Piping Components for HVAC Systems	Section 23 05 23
3.	Testing Adjusting and Balancing	Section 23 05 93
4.	HVAC Insulation	Section 23 07 00
5.	HVAC Ducts and Casings	Section 23 31 00
6.	Convection Heating and Cooling Units	Section 23 82 00

1.5 WORK NOT INCLUDED

A. Painting except as otherwise specified within this Division.

B. Electric equipment and wiring except as otherwise specified within this Division.

C. Lintels over wall openings.

D. Framing around openings and chases.

E. Concrete equipment pads or bases except concrete fill for vibration isolation bases.

F. Installation of access panels in materials other than sheet metal.

G. Cutting and patching of new and existing work.

1.6 QUALITY ASSURANCE

A. Chemical and physical properties of all materials, design, performance characteristics and methods of construction of all items of equipment shall be in accordance with the following applicable regulations, references and standards of current editions in effect 30 days prior to receipt of bids:
1. Air Movement and Control Association, Inc. (AMCA)
2. American National Standards Institute (ANSI)
3. Air Conditioning and Refrigeration Institute (ARI)
4. American Society of Heating, Refrigerating, Air Conditioning Engineers (ASHRAE)
5. American Society of Mechanical Engineers (ASME)
6. American Society for Testing and Materials (ASTM)
7. American Water Works Association (AWWA)
8. Cast Iron Soil Pipe Institute (CISPI)
9. Environmental Protection Agency (EPA)
10. Factory Insurance Association (FIA)
11. Factory Mutual Laboratories (FM)
12. Manufacturers Standards Institute (MSI)
13. National Electrical Manufacturer's Association (NEMA)
14. National Fire Protection Association (NFPA)
15. Plumbing and Drainage Institute (PDI)
16. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
17. Underwriters' Laboratories, Inc. (UL)

B. All work, materials and equipment shall comply with the rules and regulations of all codes and ordinances of the local, state and federal authorities. Such codes, when more restrictive, shall take precedence over these plans and specifications. As a minimum, the installation shall comply with the latest published version of the following codes:
1. International Building Code (IBC)
2. International Fire Code (IFC)
3. National Electric Code (NEC)
4. National Fire Code (NFC)
5. Occupational Safety and Health Act (OSHA)
6. International Mechanical Code (IMC)
7. International Plumbing Code (IPC)
8. Applicable state and local codes
9. Safe Drinking Water Act Amendment (SDWAA) 1988

C. Comply with ASME A13.1, "Scheme for the Identification of Piping Systems" for lettering size, length of color field, colors, and viewing angles of identification devices.

1.7 DEFINITIONS

A. “Furnish” shall mean the Contractor will purchase and deliver to the site the referenced piece of equipment.

B. “Install” shall mean the Contractor will connect the referenced piece of equipment so it is complete, fully functional and ready for operation.

C. “Provide” shall mean the Contractor will furnish and install the reference piece of equipment.

D. “Contractor” shall mean the Contractor performing all work associated with this Division, except the Temperature Control System.

E. “Control Contractor” shall mean the Contractor performing the work associated with the Temperature Control System.

F. “Mechanical” shall apply to all work performed under this Division of the Specifications.

G. “Owner’s Representative” shall mean the person representing the Owner of the project.

H. “Project Specifications” are the construction specifications for this project.

I. “Project Drawings” are the construction plans for this project.

J. “Contract Documents” shall mean the Project Specifications and Drawings.

K. “MSS” Manufacturers Standardization Society for the Valve and Fittings Industry.

L. “Environmental air duct” shall mean any supply or return duct conveying heating, cooling, exhaust or outside air.

M. “Kitchen hood duct” shall mean any duct conveying exhaust from a kitchen hood to the outdoors.

N. “Laboratory fume hood duct” shall mean any duct conveying exhaust from a laboratory fume hood.

O. “WOG” Water or Gas pressure.

P. “EPDM” Ethylene-propylene-diene terpolymer rubber.

Q. “TFE” Tetrafluoroethylene plastic.

1.8 CONTRACT DOCUMENTS

A. The mechanical drawings are diagrammatic in character and do not necessarily indicate every required offset, valve, fitting, etc.

B. All drawings relating to this project, together with these specifications, shall be considered in bidding and construction. The drawings and specifications are complementary, and what is called for in either of these shall be as binding as though called for by both. Should any conflict or omissions arise between the drawings and specifications, such conflict shall be brought to the attention of the Owner's Representative for resolution.

C. Unless otherwise indicated, all equipment and performance data listed is for job site conditions (elevation 4940 ft.).

D. Drawings are not to be scaled.

1.9 MATERIALS AND MANUFACTURERS

A. All materials and equipment shall be new, free of defects, installed in accordance with manufacturer's current published recommendations in a neat manner and in accordance with standard practice of the Industry.

B. Certain materials and/or equipment in this specification are specified by manufacturer and catalog numbers. The design was based on the specified equipment and establishes a degree of quality, performance, physical configuration, etc. If the Contractor should elect to use equipment other than the equipment used as a basis for design but listed as "acceptable" in the specifications, he shall be responsible for space requirements, configuration, performance and changes in, bases, supports, vibration isolators, structural members, openings in structure and other apparatus that may be affected by its use.

C. Contractor further agrees that if deviations, discrepancies, or conflicts between reviewed submittals and/or shop drawings and the Contract Documents are discovered after submittals and/or shop drawings are processed by the Owner's Representative, the Contract Documents shall control and shall be followed unless modified by addenda or change order.

1.10 SUBSTITUTION APPROVALS

A. Equipment and/or materials manufactured by any one of the manufacturers listed in the Contract Documents shall be acceptable. Where no specific manufacturer is listed, a first-class item of cataloged manufacture shall be furnished.

B. Prior Approvals: Refer to Section 01.

C. Substitution Requests after Execution of Contract: If Contractor wishes to furnish or use a substitute item of material and/or equipment, he must submit a change order request to the Owner's Representative. The request for change order shall itemize each of the proposed substitutions identified by applicable specification section, paragraph number and/or drawing number. A price change (increase or decrease) shall be listed for each item along with complete data showing performance over entire range, physical dimensions, electrical characteristics, material construction, operating weight and other applicable data. The change order request will be reviewed for equality, suitability and reasonableness of price differential. A single substitution change order listing the approved items will be issued with the net cost of the change order being the sum of the approved item costs. No subsequent substitution change orders will be considered. The Owner's Representative's decision will be final.

D. It shall be the responsibility of the Contractor to assure that the substitute material and/or equipment fits into the space provided and the Contractor shall pay for all extra costs incurred by other trades for any and all changes necessitated by these substitutions.

1.11 SUBMITTALS

A. All Section 23 product submittals shall be provided in the manner detailed below regardless of description provided elsewhere in the Contract Documents.

B. Contractor agrees that shop drawings and/or submittals processed by the Owner's Representative are not change orders. The purpose of shop drawings and/or submittals is to inform the Owner which equipment and materials the Contractor intends to provide.

C. Submittals and/or shop drawings are to be edited to show only specific data for the mechanical equipment that the Contractor intends to provide.

D. Submittals and/or shop drawings are to be identified with equipment tags identical to those listed in the Contract Documents.

E. All shop drawings for special systems (fire protection, temperature controls, etc.) that will become permanent record documents shall be prepared on sheets of 4-mil mylar of the same size as the Project Drawings.

F. Provide submittals for all products the Contractor intends to use on this project and listed in Part 2 of this Division's Specifications.

G. Submittals: All Section 23 product submittals shall be provided in the manner detailed below regardless of description provided elsewhere in the Contract Documents.
   1. All product submittals shall be provided to the Owner's Representative in a single three ring binder. Each copy of the product submittal shall be provided in an individual three ring binder. Each binder shall be white with a clear vinyl cover and contain three metal rings.
   2. Each binder shall be appropriately sized for the number of product submittals.
   3. Each binder shall contain a cover sheet with the project name, Contractor's name and submittal date.
   4. Each binder shall contain dividers which divide the product submittals into sections matching the specification sections. A table of contents identifying each section shall be included in the front of each binder.
   5. The Owner's Representative will provide two (2) reviews of the product submittals. If after two (2) reviews the submittals are not in compliance with the Contract Documents, the Contractor shall be responsible for compensating the Owner for additional submittal reviews. Compensation shall consist of shipping and delivery costs, hourly wages and other costs incurred during the additional services submittal review.

H. Shop Drawings: Provide detailed drawings indicating mechanical equipment, piping and sheetmetal systems and components, and the spatial relationship of mechanical systems and equipment with other systems, equipment, and building components. Indicate requirements for equipment installation and all access and maintenance space required. Shop drawings shall be prepared on sheets matching the sheet size and scale of the Contract Documents. Shop drawings for mechanical rooms shall be at ¼"=1'-0". Include the following in all shop drawings:
   1. Planned hydronic and plumbing piping layout, including valve and specialty locations and valve-stem movement.
   2. Planned sheetmetal layout including balance dampers, fire dampers, fire/smoke dampers, fittings, access panels, grilles, and diffusers.
   3. All equipment connected to the piping or sheetmetal system including all maintenance access and clearances for each piece of equipment.
   4. Equipment and accessory service connections and support details.
   5. Exterior wall and foundation penetrations.
   6. Fire-rated wall and floor penetrations.

7. Sizes and location of required concrete pads and bases.
8. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
9. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, and other ceiling-mounted items.

1.12 OPERATION AND MAINTENANCE MANUALS

A. The Contractor shall prepare an operation and maintenance manual which shall cover all systems and equipment installed under Division 15.

B. Refer to Section 01 for general requirements.

C. Operation and maintenance manuals shall be provided at the completion of the construction. Submit three copies of the operation and maintenance manual to the Owner's Representative for review at least two weeks prior to the substantial completion site visit. Failure to provide the operation and maintenance manuals two weeks before the substantial completion site visit will result in delaying the site visit until the manuals are received and reviewed.

D. Each operation and maintenance manual shall be indexed and contain the following information.
1. Contractors' names, addresses and telephone numbers.
2. Alphabetical list of all system components with the name and address and 24-hour phone number of the company responsible for servicing each item during the first year of operation.
3. Guarantees and warranties for all equipment whenever applicable.
4. All manufacturers' data applicable to the installed equipment, including:
    a. Approved shop drawings
    b. Installation instructions
    c. Lubrication instructions
    d. Wiring diagrams
5. A simplified description of the operation of all systems including the function of each piece of equipment within each system. These descriptions shall be supported with a schematic flow diagram when applicable.
6. Temperature control diagrams including an explanation of the control sequence of each system along with the following instructions.
    a. Emergency procedures for fire or failure of major equipment.
    b. Normal starting, operating and shutdown modes of operation.
    c. Summer or winter shutdown procedures.
7. Approved Testing, Adjusting and Balancing report.
8. Valve tag list when applicable.
9. An outline of a preventative maintenance program for each system which shall include a schedule of inspection and maintenance. It shall suggest the maintenance and inspection operations that should be performed by the Owner and the operations that should be performed by contractors.

E. Each Operation and maintenance manual shall be provided in the manner detailed below regardless of description provided elsewhere in the Contract Documents.
1. Each manual shall be provided to the Owner's Representative in a single three ring binder. Each copy of the manual shall be provided in an individual three ring binder. Each binder shall be white with a clear vinyl cover and contain three metal rings.
2. Each binder shall be appropriately sized for the information contained in the manual.
3. Each binder shall contain a cover sheet with the project name, Contractor's name and submittal date.
4. Each binder shall contain dividers that divide the manual into sections matching the information sections listed above. A table of contents identifying each section shall be included in the front of each binder.

1.13 WORKMANSHIP

A. The appearance of the finished work shall be of equal importance with its mechanical efficiency. All work shall be done in accordance with acceptable commercial practices.

B. Furnish the services of an experienced superintendent who shall be constantly in charge of the installation of the work together with all skilled workmen, plumbers, fitters, metal workers, welders, helpers, and labor required to unload, transfer, erect, connect-up, adjust, start, operate, and test each system.

1.14 SAFETY AND HEALTH REQUIREMENTS

A. These Construction Documents and the construction hereby contemplated are to be governed at all times by applicable provisions of the "Williams-Steiger Occupational Safety and Health Act of 1970, Public Law 91-596" and the latest amendments thereto.

1.15 QUIET OPERATION AND VIBRATION

A. Mechanical equipment provided under this contract shall operate under all load conditions without sound or vibration which is objectionable in the opinion of the Owner's Representative. In case of moving machinery, sound or vibration noticeable outside of room in which it is installed, or annoyingly noticeable inside its own room, will be considered objectionable. Sound or vibration conditions considered objectionable by the Owner's Representative shall be corrected in an approved manner by the Contractor at his expense. Vibration control shall be by means of approved vibration eliminators in a manner as recommended by the manufacturer of the eliminators.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Pipe Hangers and Supports:
   1. B-Line Systems, Inc.
   2. Grinnell Corp.
   3. Michigan Hanger Co., Inc.

B. Channel Support Systems:
   1. B-Line Systems, Inc.
   2. Grinnell Corp.; Power-Strut Unit.
   3. Michigan Hanger Co., Inc.; O-Strut Div.
   4. Unistrut Corp.

C. Identification and Labels:
   1. Seton Corp.
   2. Brady Co.
   3. Mechanical Identification
   4. Brimar Industries

D. Fire Stop Materials:
   1. 3M
   2. Johns Manville
   3. Specified Technologies Inc.
   4. Hilti

2.2 HANGERS AND SUPPORTS

A. Hangers:
1. Uninsulated pipe 2" and smaller: Adjustable steel swivel ring hanger, MSS-SP69 (Type 10)
2. Uninsulated pipe 2 ½" and larger: Adjustable steel clevis hanger, MSS-SP-69 (Type 1)

B. Hangers for steel piping shall be zinc-plated and hangers for copper piping shall be copper-plated. Hangers for insulated pipe shall be oversized to accommodate pipe insulation thickness.

C. Vertical risers shall be supported at each floor line with steel riser clamps, MSS-SP-69 (Type 8); carbon steel for steel and cast iron pipe, copper electroplate or plastic coating for copper pipe.

D. Except where governed by more stringent local codes, maximum hanger spacing and minimum hanger rod sizes shall comply with Table 1.

TABLE 1

Pipe Material	Pipe Size	Max. Hanger Spacing	Min. Hanger Rod Diameter
Steel, Schedule 40, filled with natural gas	1/2"	5'-0"	3/8"
	3/4"	6'-0"	3/8"
	1"	7'-0"	3/8"
	1-1/4"	8'-0"	3/8"
	1-1/2"	9'-0"	3/8"
	2"	9'-0"	3/8"
	2-1/2"	10'-0"	½"
	3"	10'-0"	½"
	4"	10'-0"	5/8"
	5"	10'-0"	5/8"

Note: Maximum hanger spacing shown in Table 1 is based on a maximum sag of 0.1" between hangers for straight pipe. Hanger spacing must be reduced to compensate for any valves and/or fittings installed in the pipe run. Spacing shall limit sag to 0.1" between hangers. Minimum hanger spacing for fire suppression piping shall be per appropriate NFPA requirements.

E. Multiple pipe runs may be supported on trapeze hangers with pipe roller support. Hanger rods shall be one size larger than size specified herein for largest pipe on trapeze. Where trapeze length exceeds 42", an additional hanger rod shall be installed at mid-span.

2.3 BEAM CLAMPS

A. Beam clamps shall be used where piping is to be suspended from building structural steel. Clamp type shall be as recommended by manufacturer based upon load to be supported and load configuration. C-clamps shall have lock nuts, cup point set screw, and restraining strap.

2.4 ELECTRICAL EQUIPMENT

A. All electrical equipment shall conform to the electrical specifications and shall be suitable for operation on the voltage and phase available at the building site. These characteristics shall be verified with the Electrical Contractor prior to ordering equipment.
   1. References:
      a. NEMA Standard MG 1: Motors and Generators
      b. NEMA Standard ICS 2: Industrial Control Devices, Controllers, and Assemblies
      c. NEMA Standard 250: Enclosures for Electrical Equipment
      d. NEMA Standard KS 1: Enclosed Switches
      e. NFPA 70: National Electrical Code
   2. Electrical components and materials shall be UL listed for intended use.
   3. This Contractor shall furnish all electrical motors, starters, disconnects, and controls required for Section 23 equipment unless specifically noted otherwise elsewhere.

B. All mechanical motors (except as noted) shall conform to the following specifications:
   1. 1/2 hp and smaller shall be single-phase, permanent-split capacitor or split phase. Shaded pole motors are not acceptable without prior approval. Integral thermal overload protection.
   2. Larger than 1/2 hp shall be three-phase, except where specifically noted otherwise.
   3. Motor Construction:
      a. NEMA Standard MG 1, 1993, general purpose, continuous duty, Design "B," except "C" where required for high starting torque.
      b. Copper windings, 40°C ambient with Class F insulation, Class B temperature rise at 100% load, unless otherwise noted.
      c. Two-speed, three-phase motors shall have two separate windings.
      d. Frames: NEMA standard as required by application.
      e. Bearings:
         1) Ball or roller bearings with inner and outer shaft seals; minimum 40,000-hour L-10 life.
         2) Permanently sealed except regreasable for 360 T and larger frames.
         3) Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.
         4) For fractional horsepower, light duty motors, sleeve type bearings are permitted.
      f. Enclosure Type:
         1) Open drip-proof motors for indoor use where satisfactorily housed and properly ventilated during operation.
         2) Weather protected Type I for outdoor use when enclosed or housed with adequate ventilation, or TEFC when exposed to weather or moist locations.
         3) Special enclosures required for hazardous areas (XP, etc.) per equipment schedules. XP motors shall be UL listed.
      g. Starting Capability: Frequency of starts not less than NEMA standard (two cold and one hot starts per hour).
      h. Service Factor: 1.15 for three-phase motors and 1.35 for single-phase motors, except 1.0 for inverter-rated motors.
      i. Noise Rating: NEMA standard (90 dba maximum for two-pole, 85 dba maximum for four or more poles).
      j. Motor Connections: Flexible conduit, except where plug-in electrical cords are specifically indicated or furnished as OEM with equipment.
   4. Motor Efficiency:
      a. All 230/460V, three-phase T-frame, single-speed, non-inverter duty motors 1 to 200 hp shall be energy-efficient type as defined in the Federal Energy Policy Act (EPACT 92). Minimum efficiencies shall be per the following table:

PREMIUM FULL-LOAD EFFICIENCY
EPACT 92 (NEMA STD. MG1, TABLE 12-6C)

	ODP			TEFC		
No. of Poles →	6	4	2	6	4	2
Motor HP						
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2

b. All other three-phase motors shall be premium efficiency type as defined in NEMA Standard MG 1-1993, Part 12, Paragraph MG 1-12.58. Nameplate efficiency shall be equal to or greater than "nominal efficiency" values given in Table 12-10.

c. Exceptions: Direct-drive motors 5 hp or less, furnished OEM on in-line and/or vertical pumps, condenser fans, furnaces, and other direct-drive applications. These motors shall be high-efficiency type whenever available from the manufacturer.

5. Motor Selection Criteria:
   a. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.
   b. Motor sizes shall be large enough that the driven load will not require the motor to operate in the service factor range at selected conditions ±20%. Minimum horsepower ratings shall be shown or scheduled on the drawings.
   c. Motors shall be selected so that operating limits (temperature rise, service factor, etc.) are not exceeded at operating altitude and rated load.
   d. Pump motors shall be "non-overloading"; i.e. shall not operate in service factor at any point on pump curve.
6. Motor Submittal Data: The following data shall be submitted for all motors:
   a. Full load current and service factor running current at operating voltage.
   b. Locked rotor current, starting power factor, and power factor at full load.
   c. Efficiency at full load.
   d. Data to substantiate Class F insulation with Class B rise at 100% load.
   e. Capacitor size (KVAR) for maximum power factor correction at 95% lagging.
   f. Synchronous and full load speeds (rpm).
   g. Enclosure type (ODP, TEFC, EXP, TENV, WPI, etc.)
   h. All tests (except locked rotor current) shall be made at full voltage and rated frequency.

C. Furnish individual combination type full NEMA rated starters with HMCP for all motors provided (except for starters that are shown to be provided with packaged equipment or in motor control centers). All combination starters shall be adequately braced for the fault current available. 42,000 AIC @ 480V, three-phase and 65,000 AIC @ 208V, three-phase shall be the minimum ratings.
1. Enclosures: NEMA Type 1, general purpose enclosures with padlock ears, except in wet locations shall be NEMA Type 3R with conduit hubs, or units in hazardous locations that shall have NEC proper class and Division XP enclosure.
2. All starters for three-phase motors shall be magnetic complete with the following accessories.
   a. Three-leg Class 10 trip-free overload protection with externally operated manual reset and visual trip indicator
   b. Separate three-phase voltage monitor to provide quick-trip on single phasing or phase reversal, automatic reset
   c. Control transformers with fused primary and secondary
   d. 120-volt holding coils

e. Integral Hand-Off-Auto switch for single-speed motors
f. Integral High-Low-Off-Auto switch for two-speed starters
g. High to low speed compelling time delay relay for two-speed starters
h. Auxiliary contacts, one N.O. and one N.C. minimum
i. "Run" pilot light

3. Two-speed, two-winding starters shall incorporate both mechanical and electrical interlocks between the high and low speed contactors and shall have individual overload current protection and auxiliary contacts for each speed.
4. Starters for single-phase motors shall be horsepower rated thermal overload switches.
5. All starters shall be full NEMA rated. IEC rated and/or NEMA equivalent rated starters are not acceptable. All starters shall be listed and labeled by NEMA, UL, and CSA.
6. Provide complete submittal data for all single and three-phase starters.
7. Approved manufacturers are Allen-Bradley, Cutler-Hammer, General Electric, Square D, and S & S.

D. Furnish all necessary control devices such as speed controls, transformers, and relays as required for proper operation of all equipment furnished under this Division.

E. Furnish all remote switches and/or push-button stations required for manually operated equipment complete with low energy pilot lights of an approved type.

F. Motors, starters, and other electrical control equipment installed in moist areas or areas of special conditions, such as explosion proof, shall be designed and approved for installation in such areas.

G. Furnish circuit and purpose identification for each remote manual switch and/or push-button station furnished herein. Identification may be either engraved plastic sign for permanent mounting to wall below switch, or stamping on switch cover plate. All such identification signs and/or switch covers in finished areas shall match other hardware in the immediate area.

2.5 IDENTIFICATION AND LABELS

A. All ductwork, piping, valves, controls, and equipment on the project shall be identified as specified herein. All identification shall be easily visible from the floor or usual point of vision. All lettering, sizes, and colors shall comply with ANSI Standard. A13.1, unless more stringent criteria are indicated below.

B. Ductwork:
1. The letters and flow arrow shall be pressure-sensitive, preprinted type or shall be made by precut stencils and black oil-base paint with aerosol can. Letters shall be a minimum of 2” high and the flow arrow shall be a minimum of 6” long.

C. Piping:
1. Provide preformed, snap-around markers that completely encircle the pipe for 360-degree visibility. Provide snap-around markers for outside diameters 3/4” through 6” and strap-around markers for outside diameters over 6”. Strap-around markers shall be secured to pipes by attached stainless steel springs or nylon ties. Self-adhesive type markers shall not be allowed.
2. Pipe markers shall identify the fluid in the piping system using the abbreviations in the table below:

Service	Identification
Natural Gas	NATURAL GAS
* Provide steam working pressure used. ** Provide refrigerant used.	

D. Each piece of equipment shall have a metal permanently fastened equipment nameplate provided by the equipment manufacturer with data engraved or stamped. Provide the manufacturer's name, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data. The equipment nameplate shall be visible, accessible, and not covered with insulation.

E. Each manual and control valve shall be identified with a 1 1/2" round brass tag, stamped or engraved with 1/4-inch lettering. Each tag shall be securely fastened to each valve with a brass bead chain or S-hook fastener.

F. Provide 1/16-inch thick, engraved plastic-laminate marker for each access panel with abbreviated terms and numbers corresponding to concealed equipment and valves. Each marker shall have 1" high white letters on a black background.

G. Provide 1/16-inch thick, engraved plastic-laminate marker for each piece of equipment with title as indicated on the Contract Documents and located in a position clearly visible from the floor. Each marker shall have 2" high white letters on a black background.

H. Provide a wood or extruded aluminum framed valve schedule with ¼" clear Plexiglas cover in each mechanical room. Each framed valve schedule shall be securely attached to the mechanical room wall.

I. Controls: All controls and instruments shall be identified with labels mounted under the control or instrument.
   1. Labels for remote devices shall be metal tags or engraved plastic laminate with letters not less than ¼" high.
   2. Labels for internal panel-mounted devices may be laminate adhesive-backed printed strips (Kroy, DuraType, or Brothers P-Touch 30) with 12-point or larger type or engraved plastic laminate. Door-mounted labels shall be engraved plastic-laminate with letters not less than ¼" high and shall be screwed or riveted to the panel door.

J. Time of Application: No identification shall be performed until all painting required under the project specifications has been accomplished.

2.6 FIRE STOP MATERIALS

A. Material shall be UL listed for filling openings around ducts and/or pipes passing through fire rated walls and floors. Fire resistance ratings shall be by testing per ASTM E814.
   1. Caulk: Intumescent latex based no-sag elastomeric caulk designed as a through penetration fire stop system.
   2. Putty: Intumescent water based elastomeric hand formable putty designed as a through penetration fire stop system.

B. All fire stop materials shall be installed per the manufacturer's UL Listed installation instructions. Provide all necessary sleeves and inserts required to meet the UL Listed installation instructions.

2.7 HANGER AND SUPPORT INSTALLATION

A. Pipe Hanger and Support Installation: Comply with MSS-SP-69 and MSS-SP-89. Install hangers, supports, clamps, and attachments as required by manufacturer's installation instructions to properly support piping from building structure.

B. Channel Support System Installation: Arrange for grouping of parallel runs of piping to be supported on field-assembled channel systems. Channel systems shall be assembled and installed according to manufacturer's installation instructions.

C. Install hangers and supports complete with necessary inserts, beam clamps, bolts, rods, nuts, washers, and other accessories.

D. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

E. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

F. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.

2.8 IDENTIFYING AND LABELING SYSTEMS

A. Ductwork:
1. Identify ductwork to indicate air handler system number, type of duct, and direction of flow. The air handler or exhaust system number shall correspond to the equipment tag indicated on the Contract Documents. The type of duct shall correspond to the type of air in the ductwork, i.e. supply air, return air , exhaust air, outside air, or relief air.
2. Provide identification for all ducts in finished and unfinished areas, machine rooms; and accessible maintenance spaces such as shafts, tunnels, and plenums according to the following:
    a. Near each main balance damper.
    b. Near each branch connection, excluding short takeoffs to grilles, diffusers, or terminal units. Mark each duct at branch, where flow pattern is not obvious.
    c. On each side of penetrations through walls or floors.
    d. At entry and exit of shafts and chases
    e. At access doors and similar access points that permit view of concealed duct.
    f. Near major equipment items and other points of origination and termination.
    g. Spaced at a maximum of 25-foot intervals along each run.
    h. On ductwork above removable acoustical ceilings.
3. Unless noted otherwise, do not identify exposed ducts in finished areas.

B. Piping:
1. Provide identification for all pipes in finished and unfinished areas, machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and at exterior nonconcealed locations according to the following:
    a. Near each valve and control device.
    b. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
    c. Near penetrations through walls, floors, ceilings, or nonaccessible enclosures.
    d. At access doors, manholes, and similar access points that permit view of concealed piping.
    e. Near major equipment items and other points of origination and termination.
    f. Spaced at a maximum of 25-foot intervals along each run.
    g. On piping above removable acoustical ceilings.

2.9 VALVE TAGS

A. Provide a valve tag for each valve and control device in the piping systems, except check valves, valves within factory-fabricated equipment units, plumbing fixture supply stops, faucets, hose bibs, and lawn-watering hose connections. List tagged valves in valve schedule.

B. Each valve tag shall identify the normal position of the valve (N.O., N.C., etc.) and conform to the following numbering system:
   1. XXXXX-XXXX=Service – Valve Number. As an example, HWS-0001 is Heating Water Supply Valve number 1.

2.10 EQUIPMENT SIGNS AND MARKERS

A. Install engraved plastic-laminate signs on each major piece of mechanical equipment. Include signs for the following general categories of equipment:
   1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
   2. Fire department hose valves and hose stations.
   3. Meters, gages, thermometers, and similar units.
   4. Fuel-burning units, including boilers, furnaces, heaters, and absorption units.
   5. Pumps, compressors, chillers, condensers, and similar motor-driven units.
   6. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
   7. Fans, blowers, primary balancing dampers, and mixing boxes.
   8. Air handling units, VAV boxes, and CV boxes.
   9. Tanks and pressure vessels.
   10. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.

2.11 DELIVERY AND STORAGE OF MATERIALS

A. Make provisions for the delivery and safe storage of materials and make the required arrangements with other Contractors for the introduction into the building of equipment too large to pass through finished openings.

2.12 MECHANICAL WIRING

A. Provide all temperature control wiring, all interlock wiring, and equipment control wiring for the equipment that is to be provided under Section 23 unless specifically shown on electrical drawings.

B. All line voltage interlock and control wiring shall be not less than No. 14 insulated color coded wire in conduit or raceway. Conductors shall be labeled at both ends.

2.13 MAINTENANCE MANUAL

A. The Contractor shall prepare a maintenance manual which shall contain maintenance information for all systems and equipment installed under this Division. Refer to Division 1 for submittal requirements.

B. The manual shall be indexed for each system and type of component and contained within a 3-ring hard cover binder. The binder shall be sized to hold all of the maintenance information. The Contractor shall cross out all references to equipment and options which were not installed on this project. Provide the following information.
   1. Contractors' names, addresses, and telephone numbers.
   2. Alphabetical list of all system components with the name, address and 24-hour phone number of the company responsible for servicing each item during the first year of operation.
   3. Guarantees and warranties of all equipment whenever applicable.
   4. All manufacturers' data applicable to the installed equipment such as the following:
      a. Approved shop drawings
      b. Installation instructions
      c. Lubrication and maintenance instructions
      d. Wiring diagrams
   5. A simplified description of the operation of each system including the function of each piece of equipment. These descriptions shall be supported with a schematic flow diagram when applicable.
   6. Temperature control diagrams including an explanation of the control sequence for each system and the following instruction wherever applicable.
      a. Emergency procedures for fire or failure of major equipment
      b. Normal starting, operating and shutdown
      c. Summer or winter shutdown
   7. System balancing report.
   8. Valve tag list when applicable.
   9. An outline of a preventative maintenance program for each system which shall include a schedule of inspection and maintenance. It shall suggest the maintenance and inspection that should be performed by the Owner and that which should be done using an outside service.

2.14 SCHEMATIC FLOW DIAGRAM

A. Prepare a schematic flow diagram for each system showing all component parts including all main isolation valves. The schematic flow diagrams presented in the Contract Documents may be used for this purpose providing they are properly edited to reflect as-built conditions. Relate all valve tag numbers to this diagram where applicable.

B. The schematic flow diagrams and the temperature control diagrams are to be wall mounted under ¼" Plexiglas in an accessible location, in the main mechanical equipment room. Provide schematic control diagrams for all large air systems (5,000 cfm and above), boiler systems, chiller systems, and steam systems. Diagrams shall show all control points and components.

2.15 SURVEYS AND MEASUREMENTS

A. Base all measurements, both horizontal and vertical, on established bench marks. All work shall agree with these established lines and levels. Verify all measurements at site and check the correctness of same as related to the work.

B. If any discrepancy between actual measurements and those indicated is discovered which prevents following good practice or the intent of the Contract Documents notify the Owner's Representative and do not proceed until instructions are received from the Owner's Representative.

2.16 SCAFFOLDING, RIGGING, AND HOISTING

A. Provide all scaffolding, rigging, hoisting, and services necessary for delivery, erection, and placement within the premises of any equipment and apparatus furnished. Remove same from premises when no longer required.

2.17 WATERPROOFING

A. Where any work pierces waterproofing, including waterproof concrete, the method of installation shall be as approved by the Owner's Representative before work is performed. Contractor shall furnish all necessary sleeves, caulking, and flashing required to make openings absolutely watertight.

B. Flashing of all building penetrations to the outside shall be per applicable codes and standards. Refer to appropriate sections for acceptable materials and methods.

2.18 GUARDS AND RAILINGS

A. Provide removable OSHA guards or railings for all belt drives and rotating machinery such as pumps. Railings shall be 1-1/2" pipe and railing fittings.

2.19 ESCUTCHEON PLATES

A. Escutcheon plates shall be provided for all exposed uninsulated pipes passing through walls, floors, and ceilings. Plates shall be nickel plated, of the split ring type, of size to match the pipe or conduit. Where plates are provided for pipes passing through sleeves that extend above the floor surface, provide deep recessed plates to conceal the pipe sleeves.

2.20 SLEEVES AND INSERTS

A. The Contractor shall provide and locate all sleeves and inserts required before the floors and walls are built, or shall be responsible for the cost of cutting and patching required for pipes where sleeves and inserts were not installed or where incorrectly located. Each Contractor shall do all drilling required for the installation of his hangers.

B. Sleeves shall be provided for all mechanical piping passing through concrete floor slabs and concrete, masonry, tile, and gypsum wall construction. Sleeves in poured concrete that are to be flush with the finished surfaces shall be constructed of 24 Ga. galvanized sheet metal with lock seam joints. All other sleeves shall be constructed as follows unless otherwise indicated on the drawings.
   1. Sheet Metal Sleeves: 10-gauge galvanized sheet metal, round tube closed with welded longitudinal joint.
   2. Pipe Sleeves: Schedule 40 galvanized welded steel pipe, ASTM A53, Grade A.

C. Sleeves in Exterior Walls Below Grade:
   1. Shall be Schedule 40 pipe per item 2 above.
   2. Seals shall be modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates that cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

D. Where pipe motion due to expansion and contraction will occur, make sleeves of sufficient diameter to permit free movement of pipe. Where sleeves pass insulated pipes, the sleeves shall be large enough to pass the pipe only and the insulation shall be made to butt against the construction except for pipes requiring insulation having a vapor barrier, in which case the sleeves shall be large enough to pass the pipe and insulation. Check floor and wall construction finishes to determine proper length of sleeves for various locations; make actual lengths to suit the following.
   1. Terminate sleeves flush with walls, partitions, and ceiling.
   2. In areas where pipes are concealed, as in chases, terminate sleeves flush with floor.
   3. In all areas where pipes are exposed, extend sleeves 1/4" to 1/2” above the finished floor, except in rooms having floor drains where the sleeves shall be extended 2" above the finished floor.

E. Fasten sleeves securely in floors and walls, so they will not become displaced when concrete is poured or when other construction is built around them. Take precautions to prevent concrete, plaster, or other materials from being forced into the space between pipe and sleeve during construction.

F. In all areas where ducts are exposed and ducts are passing through floor, the hole shall be surrounded by a 4"-high by 3"-wide concrete curb.

G. Provide a man present with the General Contractor during the pouring of the concrete to make sure that the location of the sleeves is not disturbed during the pour.

2.21 HOLES IN PRECAST CONCRETE

A. All openings in precast concrete over 6" square or 6" diameter shall be cast in place at the time of fabrication. The Mechanical Contractor shall cut all openings 6" and under at the site or shall make proper arrangements with the fabricator to cast same during fabrication. All openings if cut shall be cut with rotary-type drill, or other method as approved by the Owner’s Representative. Holes cut with pneumatic hammer will not be accepted.

2.22 OLD PIPE LINES

A. If any old sewer, water, gas, or other pipes are encountered that interfere with the proper installation of new work and that will not be used in connections with the new work, promptly advise the General Contractor and Owner’s Representative.

2.23 SUPPORTING STEEL

A. Provide structural steel framework for supporting mechanical equipment.

B. All steel work shall be in conformance with the requirements of the AISC Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings. Material shall conform to ASTM A36.

C. Bases and supports shall be constructed as detailed on approved shop drawings provided by the Contractor.

D. All structural steel shall receive one coat of industrial enamel primer in the shop after all fabrication welding is complete. Paint all field joints with one coat of industrial enamel primer. After all steel is properly primed, paint with two coats of exterior grade enamel. Color as selected by the Owner’s Representative.

2.24 COORDINATION AND COOPERATION WITH OTHER TRADES

A. The Contractor for this work shall examine the Contract Documents for other trades. If clearance or space conditions appear inadequate or if any discrepancies occur between his work and the work of others, he shall report such discrepancies to the Owner's Representative and shall obtain written instructions for any changes necessary to accommodate his work with the work of others. Any changes in the work covered by the Contract Documents made necessary by the failure or neglect of the Contractor to report such discrepancies shall be made by and at the expense of this Contractor.

B. Where the mechanical work will be installed in close proximity to, or will interfere with work of other trades, the Contractor shall assist in working out space conditions to make a satisfactory adjustment. If so directed by the Owner's Representative, the Contractor shall prepare composite working drawings and sections at a suitable scale not less than 1/4" = 1'-0", clearly showing how his work is to be installed in relation to the work of other trades. If the Contractor installs his work before coordinating with other trades, or so as to cause any interference with work of other trades, he shall make the necessary changes in his work to correct the condition without extra charge.

2.25 INSTALLATION

A. Unless otherwise specifically indicated on the plans or specifications, all equipment and materials shall be installed in accordance with the recommendations of the manufacturer. Maintain maximum head room and space conditions at all points.

B. Coordinate work with other trades prior to fabrication and installation of equipment, piping, and ductwork. Adjust ductwork and piping to fit into space available.

2.26 ACCESSIBILITY

A. Locate all equipment that must be serviced, operated, or maintained in fully accessible positions. Equipment shall include, but not be limited to, valves, traps, clean-outs, motors, controllers, switchgear, and drain points. If required for accessibility, furnish access doors for this purpose. Minor deviations from drawings may be made to allow for better accessibility.

2.27 PAINTING

A. Paint field-fabricated hangers and frames, unpainted equipment, and uninsulated exposed piping (interior and exterior) with one coat of primer and two coats of flat enamel paint, color as selected by Owner's Representative.

2.28 CLEANUP

A. At the completion of work, all equipment on the project shall be checked and thoroughly cleaned including coils, plenums, under equipment and any and all other areas around or in equipment provided under this section. Clean all exposed surfaces of all piping, hangers, ducts, and other exposed metal of all grease, plaster, or other foreign material. Remove all stick-on labels and clean surfaces.

B. At the completion of the work, remove from the building, the premises, and surrounding streets, alleys, etc., all rubbish and debris resulting from this project and leave all equipment spaces absolutely clean and ready for use.

C. Any filters used during construction shall be replaced with new filters during final cleanup.

2.29 DAMAGED SURFACES

A. At the completion of work, all mechanical equipment furnished under this contract shall be checked for paint damage, and any factory finished paint that has been damaged shall be repaired to match the adjacent areas. Any metal cabinet, jacket, or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

2.30 PROTECTION

A. The Contractor shall protect all work and material from damage by his work or workmen, and shall be liable for all damage thus caused.

B. The Contractor shall be responsible for work and equipment until finally inspected, tested, and accepted; he shall protect work against theft, injury, or damage; and shall carefully store material and equipment received on site that is not immediately installed. He shall close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

2.31 RECORD OF CHANGES

A. Refer to Division 1 for requirements.

2.32 RESPONSIBILITY OF CONTRACTOR

A. The Contractor is responsible for the complete and satisfactory installation of the systems and equipment in accordance with the intent of the Contract Documents. As part of his work, he shall provide all incidental items necessary to provide a complete and operational system. He shall coordinate the installation of the multiple components and parts so that the completed system will function as intended by the Contract Documents. At the completion of the project, he shall provide a system with all components and parts adjusted and in proper working order.

END OF SECTION 23 05 00

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SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section describes general requirements for testing, adjusting, and balancing (TAB) of the environmental systems.

1.2 SUMMARY

A. This section includes the following materials and methods.
   1. General TAB Requirements
   2. Air system Balancing

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. The General Conditions of the Contract, Supplementary Conditions and General Requirements are a part of the Project Specification and shall be used in conjunction with this Division as a part of the Contract Documents. Consult them for further instructions pertaining to this work. Contractors shall be responsible for and be governed by all requirements thereunder.

B. Related Sections:

1.	Common Work Results for HVAC Systems	Section 23 05 00
2.	Testing Adjusting and Balancing	Section 23 05 93
3.	HVAC Fans	Section 23 34 00

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. Pre-qualified TAB firms for this project are:
      a. Midwest
      b. Griffith Engineering Services
      c. JPG Engineering
   2. Other qualified firms desiring to furnish services for this project shall submit for written approval, during bid time, a brochure listing the qualifications of personnel in the organization, instruments available to be used, an outline of system balancing procedures that is intended to be followed, and a list of projects successfully balanced within the last two years. Information regarding additional qualifications listed below must be in the office of the Engineer at least 14 calendar days prior to the date set for receiving bids.

3. TAB firm shall:
    a. Have had previous experience with at least one project of similar type and size within the State of Colorado. Provide the project(s) name, owner, general contractor, mechanical contractor, and references with phone numbers for each.
    b. Have a permanent place of business and phone number within a 200-mile radius of the job site.
    c. Have been actively engaged in balancing work within the State of Colorado for at least three of the past five years. Provide at least three project references with phone numbers.
4. The TAB field work shall be performed under the direct supervision of a registered Professional Engineer who has had at least five years of balancing experience in the state in which the work is being done or a NEBB or AABC certified TAB supervisor. The PE or certified supervisor may:
    a. Perform the TAB work or be on-site at least 33% of the total time the TAB work is in progress, or
    b. Be on site a minimum of 10% of the total time the TAB work is in progress with the work performed by a full-time certified TAB Technician who has been certified by the Sheet Metal Industry National Certification Board.

B. Certifications:
1. Testing, adjusting, and balancing shall be done by a firm using NEBB or AABC certified supervisors, or by an independent firm specializing in this work. A definition of independent shall mean the firm is not associated with the Mechanical Contractor performing work under Division 23; the firm derives its income solely from testing, adjusting, and balancing and/or commissioning mechanical systems, and the work is performed in a professional manner.
2. TAB firm shall own or rent and have available for this project all necessary balancing instruments as required to maintain NEBB or AABC certification. Instrument calibration shall have been checked and verified as per NEBB requirements. Provide instrument list with calibration date for each instrument listed.

C. Regulatory Requirements:
1. Refer to Section 23 05 00 for general code, standard and regulatory requirements.
2. Comply with procedural standards for testing, adjusting, and balancing of environmental systems as outlined in the latest edition of SMACNA, NEBB, and/or AABC procedural manuals.
3. Applicable sections and paragraphs as published in ASHRAE 2003 Applications Handbook, Chapter 34, Testing, Adjusting, and Balancing, and Standard 111-1988.

1.5 SUBMITTALS

A. Submit proposed TAB forms and report formats to Owner or his representative for approval at least 120 days prior to commencing field work.

B. Quality Assurance/Control Submittals:
1. Within 30 days after contract award, submit the name(s) of the professional engineer and/or the NEBB or AABC certified supervisor who will be supervising this work. Submit the name(s) of the TAB technician(s) who will be performing the work.

C. Closeout Submittals:
1. TAB Report: After all balancing is complete, and all coordination with the Commissioning Contractor and the Owner or his representative is complete, the balancing firm shall furnish four bound reports which shall contain the following information:
    a. Belt and drive sheave information as installed and as changed, fan nameplate information, motor nameplate information, and amperage and voltage to all motors in various operating modes where applicable. Also, maximum and minimum rpm settings on VFD units.
    b. Static pressure drops across all components of the air systems. Static pressure profile for each air handling unit system.

c. Required and final balanced cfm at each system terminal unit. Include the terminal size, inlet size, inlet static pressure, temperature, and velocities read to attain the required cfm.
d. Refrigerant system operating amperages, pressures, and temperatures.
e. Overload protection data for all motors shall be recorded. Starter and/or VFD brand, model, enclosure type, installed overload devices, original ratings and set points (and revised device ratings and set points when applicable) shall be recorded. If the starters and/or VFDs were furnished by the Mechanical Contractor, the overloads shall be verified and changed to the correct size when necessary, and so noted in the report. If the starters were furnished by the Electrical Contractor, the correct overload device sizes and settings shall be noted in the report and the Electrical Contractor shall be advised of all discrepancies.
f. The method of balance, the instruments used with calibration history, the project altitude, and any correction factors used in the calculations shall be reported.
g. A reduced set of drawings (11" x 17") shall be included in the report with all terminals, VAV boxes, air outlets, inlets, coils, unit heaters, fin tube loops, radiant panel loops, etc., clearly marked, all equipment designated, and all referenced to the device test reports. The contract drawings may be reduced and used for this purpose, if they remain legible.
h. The TAB Contractor shall submit bound copies of the final testing and balancing report to the Owner or his representative at least 15 days prior to the Mechanical Contractor's request for final inspection. All data shall be recorded on applicable reporting forms. The report shall include all operating data as previously listed, a list of all equipment used in the testing and balancing work, and shall be signed by the supervising registered engineer or certified TAB supervisor and certified TAB technician, and affixed with his certification seal. Final acceptance of this project will not take place until a satisfactory report is received.

2. Balance report shall not be submitted until all all improperly configured or installed systems are corrected and improperly installed or missing balance devices are corrected and tested reports submitted with incomplete information will be returned unreviewed.

1.6 SCHEDULING

A. Coordinate scheduling of work with the General Contractor, the appropriate subcontractors.
   1. Schedule TAB work to coincide with testing and verification of control systems where practical.

B. Provide written notification within 24 hours to the General Contractor, Engineer, and Owner’s Representative of any component and/or system deficiencies.

1.7 RETAINAGE

A. Contract payment retainage may be withheld against the General Contractor until the final completion of this section of work has been demonstrated by the submission of the TAB report, and an evaluation of its contents has been made by the Owner’s Representative.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Provide all necessary tools, scaffolding, and ladders.

B. Provide all necessary instruments. Calibration and maintenance of instruments shall be in accordance with SMACNA, NEBB, AABC, and/or the manufacturer's standards and recommendations.
   1. Calibration histories for each instrument shall be available for examination.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Air testing and balancing shall not begin until the system to be tested has been cleaned and is in full working order.

B. Preliminary TAB requirements shall be ascertained prior to the commencement of work through a review of available plans and specifications for the project. In addition, visual observations at the site during construction shall have been made to determine the location of required balancing devices, that they are being installed properly, and acceptable access is provided.

C. Prior to and during testing and balancing, TAB contractor shall immediately notify the Contractor of all balancing devices not yet installed and those portions of the system unable to be balanced. The Contractor shall correct the deficiencies and shall notify the Engineer of situations requiring additional instruction.

D. Before any air balance work is done, the system shall be checked for:
   1. Excessive duct leakage
   2. Dirt and debris in ducts and/or AHUs
   3. Filters are installed (and changed if they are dirty)
   4. Coil fins are clean and combed where needed
   5. Correct motor rotation
   6. Excessive vibration
   7. Equipment lubrication
   8. Proper operation of automatic control and smoke dampers
   9. Manual control dampers, fire dampers, and air outlet dampers are wide open
   10. Duct end caps installed and access doors closed
   11. Grilles, registers, and diffusers are properly installed

E. Put heating, ventilating, and air conditioning systems and equipment into full operation and continue operation of same during each working day of testing and balancing.

3.2 REQUIREMENTS OF WORK

A. Adjust air handling systems to the following tolerances:
   1. Supply systems shall be balanced so that:
      a. The total quantity to each space is within -5% to +10% of design values.
      b. If two outlets in space, each outlet is within -10% to +10% of design value.
      c. If three or more outlets in space, each outlet is within -15% to +15% of design value.
   2. Exhaust and return systems shall be balanced so the total quantity from each space is -10% to +10% of design values.

B. Air Balance:

1. Air supply, return, and exhaust systems with air quantities for each air device.
   a. Air handling units including supply, return, mixed, and outside air temperatures
   b. Fan data including cfm, static pressure, fan rpm, motor running amperage; (and full load amperage) before and after final balance.
2. Air diffuser patterns shall be set to minimize objectionable drafts and noise.
3. The supply, return, and exhaust fan static pressures shall be set by the balancing firm (and the Controls Contractor if the systems have fan volume control).
   a. The pitot tube traverse method for determining main duct cfm shall be used and recorded wherever possible; flow hood measurements at registers and diffusers may be totalized for branch duct quantities.
   b. The supply air system shall be tested in all operating modes (full return air, full outside air, full cooling with the design diversity, and full cooling with no diversity).
   c. After balancing is completed, check fan motor amperage with the filters clean.
   d. System static pressure profiles and fan motor amperages shall be recorded in all modes.
   e. The lowest fan speed resulting in satisfactory system performance shall be determined at full design delivery. Any inlet or outlet fan volume (balancing) dampers shall be in the wide-open position and one path presenting the greatest resistance to flow shall be fully open and unobstructed.
   f. After balancing, all adjustable speed sheaves 7-1/2 hp and larger shall be replaced with fixed-speed sheaves by the TAB Contractor.
4. Provide system static pressure profiles which identify pressure differences across all components of air handling units and built-up systems. Pressure drops shall be individually measured and recorded for intake and exhaust vents, hoods, louvers, manual and auto control dampers, filters, coils, evap. coolers, fans, terminal units, etc.
   a. On systems with OSA economizers, pressure drop values shall be recorded for both minimum and 100% OSA modes.
   b. On multi-zone air handlers, all zone dampers shall be checked for excessive leakage at both full heat and full cool positions. Manual zone balance dampers shall then be set. Correct location and operation of zone thermostats shall be verified.
5. Building static pressure adjacent to entries shall be measured and recorded. Adjust systems to maintain a positive pressure of 0.05-inch w.c. when possible. Note any discrepancies.
6. Final adjustments shall include but not be limited to the following:

ITEM	ADJUSTMENT
Fan: Belt Drive	RPM: Include sheave and belt exchange as required to deliver air flow within limits of installed motor horsepower and mechanical stress limits of the fan. Determine the limiting fan tip speed before increasing rpm. Final fan speed setting shall allow for predicted filter loading and shall provide proper duct pressures for operation of zone cfm regulators where used. Note: Fan rpm shall not be increased more than 10% from the factory setting without prior authorization by the Engineer.
Fan: Direct Drive	RPM with Speed Taps: Set fan speed on tap which most closely approaches design cfm. Report tap setting on equipment data sheet. RPM with Speed Control Rheostat: Set output of fan to design cfm by adjusting the SCR. After adjustment, check fan's ability to restart after powering down. Increase SCR setting if required for proper starting. CFM with Variable Pitch Blades: Variable fixed pitch fan blades and variable in-motion pitch fan blades shall be adjusted initially by the manufacturer at pitch required to provide design output. Check and readjust if necessary to obtain design cfm. Pitch angle adjustment shall not exceed recommended maximum to prevent "stall."

ITEM	ADJUSTMENT
Outside Air	Manual Dampers: Adjust manual dampers (and/or OSA fan capacity) as necessary to obtain design OSA cfm. Automatic Dampers: Adjust the maximum open position of separate minimum OSA dampers (or the minimum open position of economizer OSA dampers) as necessary to obtain design minimum OSA cfm. Quantity of OSA: Shall be measured directly using a velocity traverse (or pitot tube traverse when separately ducted), or shall be calculated using return air, OSA, and resultant mixed air temperatures.
Registers and Diffusers	Registers, diffusers, etc., are to be adjusted to deliver design air quantities per paragraph 3.2-A.
Motor Starter - Overload Trip Devices	Mechanical Contractor Furnished VFD, Magnetic, and Manual Starters: Exchange or reset overload devices as required for proper motor protection. Electrical Contractor Furnished Motor Control Center Magnetic Starters: Check overload devices for correct sizing and/or setting. Notify the Electrical Contractor of any discrepancies.

7. When air balancing is done and manual dampers are set, all test holes shall be plugged and all manual damper positions shall be marked. The following information shall be recorded in the final report: Design inlet or outlet size, actual inlet or outlet size, and design cfm (velocity) through the orifice for each terminal in the system.

C. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.3 FIELD QUALITY CONTROL

A. Upon request of the Engineer, a representative of the balancing firm performing the work shall demonstrate to him fluid flow quantities shown in the report by reading back outlets or terminals selected at random by the Engineer. It is understood that the operating mode of the system shall be the same for readback as it was during balancing, and the number of readings verified will not exceed 10% of the total in the report.

B. When deemed necessary by the Owner's Representative or Engineer, the balancing firm shall run temperature, pressure, and/or humidity recordings, and shall be prepared to verify any of the report test results in the presence of the Owner's Representative and/or Engineer when requested.

C. When deemed necessary by the Engineer, a 24-hour space temperature recording shall be taken and any required partial rebalance of the system shall be performed without any additional cost.

END OF SECTION 23 05 93

SECTION 23 07 00

HVAC INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section includes semi-rigid and flexible duct, plenum, and breeching insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

1.2 SUMMARY

A. This section includes the following materials and methods.
   1. Mineral-Fiber Insulation

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. The General Conditions of the Contract, Supplementary Conditions and General Requirements are a part of the Project Specification and shall be used in conjunction with this Division as a part of the Contract Documents. Consult them for further instructions pertaining to this work. Contractors shall be responsible for and be governed by all requirements thereunder.

B. Related Sections:

1.	Common Work Results for HVAC Systems	Section 23 05 00
2.	HVAC Insulation	Section 23 07 00
3.	HVAC Ducts and Casings	Section 23 31 00

1.4 QUALITY ASSURANCE

A. All components of the insulation system including insulation, facing, mastic, and adhesives, except elastomeric material specified elsewhere, shall not exceed the following hazard ratings as determined by NFPA 255, ASTM E84, and UL 723. For piping insulation systems: flame spread rating of 25, Fuel contributed rating of 25, and Smoke developed rating of 50. For duct insulation systems: Flame spread rating of 25, Fuel contributed rating of 0, and Smoke developed rating of 50.

B. Protect insulation against dirt, water, chemical, or mechanical damage before, during, and after installation. Any such insulation or covering damaged prior to final acceptance of the work shall be satisfactorily repaired or replaced.

1.5 SUBMITTALS

A. Submit manufacturer's technical product data, installation instructions, and maintenance data for each type of mechanical insulation, including fittings, adhesives, and jacket.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Mineral-Fiber Insulation:
   1. CertainTeed
   2. Knauf Fiberglass
   3. Owens-Corning Fiberglas Corp.
   4. Schuller International, Inc.

2.2 INSULATION

A. Specification Type “B”: Fiberglass insulation board complying with ASTM C 612, Type IB. The board insulation shall be preformed, flat, rectangular, rigid material 2” thick, 3.0 lbs./cu. Ft. density, with a maximum “K” value of 0.22 at 75 degree mean temperature.

B. Specification Type “C”: Fiberglass insulation board complying with ASTM C 612, Type IB, with factory applied heavy duty FSK facing The board insulation shall be preformed, flat, rectangular, rigid material 1 ½” thick, 3.0 lbs./cu. Ft. density, with a maximum “K” value of 0.22 at 75 degree mean temperature.

C. Specification Type “D”: Fiberglass insulation board complying with ASTM C 612, Type IB, with factory applied heavy duty FSK facing. The board insulation shall be preformed, flat, rectangular, rigid material 2” thick, 3.0 lbs./cu. Ft. density, with a maximum “K” value of 0.22 at 75 degree mean temperature.

D. Specification Type “G”: Fiberglass blanket insulation comply with ASTM C 553, Type II, with heavy duty FSK vapor barrier facing. Blanket shall be 1 ½” thick, ¾ lbs./cu. Ft. density, with a maximum “K” value of 0.28 at 75 degree mean temperature.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely effect insulation application.

B. Insulation shall be applied after testing duct or piping systems.

3.2 GENERAL APPLICATION REQUIREMENTS

A. Insulation shall be installed by workmen regularly engaged in this kind of work in strict accordance with the manufacturer's recommendations and recognized industry practices.

B. Refer to schedules at the end of this Section for materials, forms, jackets, and thickness required for each insulation system.

C. When installing multiple layers of insulation, stagger the longitudinal and end seams.

D. Keep insulation materials dry during application and finishing.

E. Apply insulation with the least number of joints practical.

F. For insulation application where a vapor barrier is indicated, seal ends as recommended by the insulation manufacturer to maintain vapor barrier.

G. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.

H. Pipe and duct insulation shall be continuous through walls and floor openings except where walls and floors are required to have a fire resistant rating. At fire resistant penetrations, stop the insulation on each side of the penetration and fill the open space remaining between the sleeve and pipe and/or duct with fire-stop insulation. Duct linings shall be interrupted at fire dampers and fire doors so as not to interfere with their operation. Duct coverings and linings shall be interrupted duct electric resistance or fuel burning heaters.

I. Insulation for all cold surfaces must be installed with a continuous, unbroken vapor barrier. Supports, anchors, etc., that are secured directly to cold surfaces must be adequately insulated and provided with a vapor barrier to prevent condensation.

J. For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor barrier mastic.

3.3 DUCT AND EQUIPMENT INSULATION APPLICATION

A. Blanket Applications for Ducts, Plenums, and Equipment:
1. All edges shall be tightly butted together with facing overlapping all joints at least 2". Insulation shall be attached to the ductwork using a fire retardant adhesive.
2. Where a vapor barrier is required, all joints shall be sealed with a fire retardant adhesive and 3" wide tape of same material as insulation facing.
3. Provide mechanical fasteners, in addition to the fire retardant adhesive, on the underside of all ducts over 30" wide.
4. Repair all breaks or punctures of vapor barrier with vapor barrier tape and fire retardant adhesive.
5. All adhesives shall be as recommended by the insulation manufacturer and applied according to manufacturer's recommended instructions.
6. Apply adhesive to all duct surfaces and to all surfaces of fittings and transitions.
7. Groove and score insulation materials to fit as closely as possible to the equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joint. Stagger end joints.
8. Do not weld mechanical fasteners to ASME-labeled pressure vessels.
9. Bevel and seal insulation ends around access doors, manholes, handholes, ASME stamps, and nameplates.
10. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames, and accessories.

B. Board Applications for Ducts, Plenums, and Equipment:
1. All edges shall be tightly butted together. Insulation shall be attached to the ductwork using mechanical fasteners spaced at 12" o.c..
2. Where a vapor barrier is required, all joints shall be sealed with a fire retardant adhesive and 3" wide tape of same material as insulation facing.
3. Where a vapor barrier is not required, all joints shall be sealed with a fire retardant adhesive and 3" wide glass cloth tape.
4. Repair all breaks or punctures of vapor barrier with 3" wide vapor barrier tape and fire retardant adhesive.
5. All adhesives shall be as recommended by the insulation manufacturer and applied according to manufacturer's recommended instructions.
6. Cut excess portion of mechanical fasteners extending beyond insulation and cover exposed with tape matching insulation facing.

7. Groove and score insulation materials to fit as closely as possible to the equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joint. Stagger end joints.
8. Do not weld mechanical fasteners to ASME-labeled pressure vessels.
9. Bevel and seal insulation ends around access doors, manholes, handholes, ASME stamps, and nameplates.
10. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames, and accessories.

3.4 FIELD-APPLIED JACKET APPLICATION

A. Apply canvas jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.
1. Apply canvas jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed canvas jacket between two thick coats of jacket manufacturer's recommended adhesive.
3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.

3.5 SYSTEM APPLICATIONS

A. Insulation materials are specified in schedules at the end of this Section.

B. Unless otherwise indicated, do not insulate the following systems or equipment:
1. Metal ducts with duct liner.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
4. Flexible connectors.
5. Vibration-control devices.
6. Testing agency labels and stamps.
7. Nameplates and data plates.
8. Access panels and doors in air-distribution systems.
9. Manholes.
10. Handholes.
11. Cleanouts.
12. Fire-suppression piping.
13. Drainage piping located in crawl spaces, unless otherwise indicated.
14. Below-grade piping, unless otherwise indicated.
15. Chrome-plated pipes and fittings, unless potential for personnel injury.
16. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.

3.6 INSULATION APPLICATION SCHEULE

Duct and Equipment Insulation Schedule		
System	Type	Vapor Barrier
Concealed Rectangular HVAC Supply Duct	C*	Yes
Concealed Rectangular HVAC Return Duct	C*	No
Concealed Round HVAC Supply Duct	G*	Yes
Concealed Round HVAC Return Duct	G*	No
Exposed Rectangular HVAC Supply Duct	----	No
Exposed Rectangular HVAC Return Duct	----	No
Exposed Round HVAC Supply Duct	----	No
Exposed Round HVAC Return Duct	----	No
Outside Air Ducts	B	Yes
Relief Air Ducts	D*	Yes
Exhaust Air Ducts	D*	Yes
• Relief and exhaust duct insulation shall be installed between the building discharge and th shut off damper. Insulation shall be provided on supply and return ducts when installed in locations outside the building envelop.		

END OF SECTION 23 07 00

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SECTION 23 08 00

COMMISSIONING OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Commissioning. Commissioning is a systematic process of ensuring that all building systems perform interactively according to the design intent and the owner's operational needs. This is achieved by beginning in the design phase and documenting design intent and continuing through construction, acceptance and the warranty period with actual verification of performance. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:
   1. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
   2. Verify and document proper performance of equipment and systems.
   3. Verify that O&M documentation left on site is complete.
   4. Verify that the Owner's operating personnel are adequately trained.

B. The commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.

C. Abbreviations. The following are common abbreviations used in the *Specifications* and in the *Commissioning Plan.* Definitions are found in Section 1.6.

A/E-	Architect and design engineers	FT-	Functional performance test
CA-	Commissioning authority	GC-	General contractor (prime)
CC	Controls contractor	MC-	Mechanical contractor
CM-	Construction Manager (the owner's representative)	PC-	Prefunctional checklist
Cx-	Commissioning	PM-	Project manager (of the Owner)
Cx Plan-	Commissioning Plan document	Subs-	Subcontractors to General
EC-	Electrical contractor	TAB-	Test and balance contractor

1.2 COORDINATION

A. Commissioning Team. The members of the commissioning team consist of the Commissioning authority (CA), the General Contractor (GC or Contractor), the mechanical engineer (ME), the Mechanical Contractor (MC), the TAB representative and any other installing subcontractors or suppliers of HVAC equipment. If known, the Owner's building or plant operator/engineer is also a member of the commissioning team.

B. Management. The CA is hired by the Owner directly. The CA directs and coordinates the commissioning activities and the reports to the Owner. All members work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents. The CA's responsibilities are the

same regardless of who hired the CA. Refer to Section 23 08 00 Part 1.6 for additional management details. The following organization chart clarifies the roles.

C. Scheduling. The CA will work with the GC according to established protocols to schedule the commissioning activities. The CA will provide sufficient notice to the GC for scheduling commissioning activities. The GC will integrate all commissioning activities into the master schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.

D. The CA will provide the initial schedule of primary commissioning events during the weekly construction meetings.

1.3 COMMISSIONING PROCESS

A. Commissioning Plan. The commissioning plan provides guidance in the execution of the commissioning process. Just after the initial commissioning scoping meeting the CA will update the plan which is then considered the "final" plan, though it will continue to evolve and expand as the project progresses. The *Specifications* will take precedence over the *Commissioning Plan*.

B. Commissioning Process. The following narrative provides a brief overview of the typical commissioning tasks during construction and the general order in which they occur.

1. Commissioning during construction begins with a scoping meeting conducted by the CA where the commissioning process is reviewed with the commissioning team members.
2. Additional meetings will be required throughout construction, scheduled by the CA with necessary parties attending, to plan, scope, coordinate, schedule future activities and resolve problems.
3. Equipment documentation is submitted to the CA during normal submittals, including detailed start-up procedures.
4. The CA works with the Subs in developing startup plans and startup documentation formats, including providing the Subs with prefunctional checklists to be completed, during the startup process.
5. In general, the checkout and performance verification proceeds from simple to complex; from component level to equipment to systems and intersystem levels with prefunctional checklists being completed before functional testing.
6. The Subs, under their own direction, execute and document and perform startup and initial checkout. The CA documents that the checklists and startup were completed according to the approved plans. This may include the CA witnessing start-up of selected equipment.
7. The CA develops specific equipment and system functional performance test procedures. The Subs review the procedures.
8. The procedures are executed by the Subs, under the direction of, and documented by the CA.
9. Items of non-compliance in material, installation or setup are corrected at the Sub's expense and the system retested.
10. The CA reviews the O&M documentation for completeness.
11. Commissioning is completed before Substantial Completion.
12. The CA reviews, pre-approves and coordinates the training provided by the Subs and verifies that is was completed.
13. Deferred testing is conducted, as specified or required.

1.4 RESPONSIBILITIES

A. The responsibilities of various parties in the commissioning process are provided in this section. The responsibilities of the mechanical contractor, TAB and controls contractor are in Division 23. It is noted that the services for the Project Manager, Construction Manager, Architect, HVAC mechanical and electrical designers/engineers, and Commissioning authority are not provided for in this contract. That is,

the Contractor is not responsible for providing their services. Their responsibilities are listed here to clarify the commissioning process.

B. All Parties
1. Follow the Commissioning Plan.
2. Attend commissioning scoping meeting and additional meetings, as necessary.

C. Mechanical Engineers (of the A/E)

Construction and Acceptance Phase

1. Perform normal submittal review, construction observation, as-built drawing preparation, etc., as contracted. One site observation should be completed just prior to system startup.
2. Provide any design narrative and sequences documentation requested by the CA. The designers shall assist (along with the contractors) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
3. Attend commissioning scoping meetings and other selected commissioning team meetings.
4. Participate in the resolution of system deficiencies identified during commissioning, according to the contract documents.
5. Prepare and submit the final as-built design intent and operating parameters documentation for inclusion in the O&M manuals. Review and approve the O&M manuals.
6. From the Contractor's red-line drawings, edit and update one-line diagrams developed as part of the design narrative documentation and those provided by the vendor as shop drawings for the chilled and hot water, condenser water, domestic water, steam and condensate systems; supply, return and exhaust air systems and emergency power system.
7. Provide a presentation at one of the training sessions for the Owner's personnel.
8. Review and Approve the functional test procedure forms for major pieces of equipment for sufficiency prior to their use.
9. Witness testing of selected pieces of equipment and systems:

Warranty Period

10. Participate in the resolution of non-compliance, non-conformance and design deficiencies identified during commissioning during warranty-period commissioning.

D. Commissioning Authority (CA)
1. The CA is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management. The CA may assist with problem-solving non-conformance or deficiencies, but ultimately that responsibility resides with the general contractor and the A/E. The primary role of the CA is to develop and coordinate the execution of a testing plan, observe and document performance that systems are functioning in accordance with the documented design intent and in accordance with the Contract Documents. The Contractors will provide all tools or the use of tools to start, check-out and functionally test equipment and systems, except for specified testing with portable data-loggers, which shall be supplied and installed by the CA.

Construction and Acceptance Phase

2. Coordinates and directs the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules and technical expertise.
3. Coordinate the commissioning work and, with the GC and CM, ensure that commissioning activities are being scheduled into the master schedule.
4. Revise, as necessary, the Draft 2, Commissioning Plan—Construction Phase.
5. Plan and conduct a commissioning scoping meeting and other commissioning meetings.
6. Request and review additional information required to perform commissioning tasks, including O&M materials, contractor start-up and checkout procedures.
7. Before startup, gather and review the current control sequences and interlocks and work with contractors and design engineers until sufficient clarity has been obtained, in writing, to be able to write detailed testing procedures.

8. Review and approve normal Contractor submittals applicable to systems being commissioned for compliance with commissioning needs, concurrent with the A/E reviews.
9. Develop an enhanced start-up and initial systems checkout plan with Subs.
10. Perform site visits, as necessary, to observe component and system installations. Attends selected planning and job-site meetings to obtain information on construction progress. Review construction meeting minutes for revisions/substitutions relating to the commissioning process. Assist in resolving any discrepancies.
11. Witness all or part of any ductwork testing and cleaning procedures, sufficient to be confident that proper procedures were followed. Document this testing and include the documentation in O&M manuals. Notify owner's project manager of any deficiencies in results or procedures.
12. Approve systems startup by reviewing start-up reports and by selected site observation.
13. Review TAB execution plan.
14. Oversee sufficient functional testing of the control system and approve it to be used for TAB, before TAB is executed.
15. Approve air and water systems balancing by spot testing, by reviewing completed reports and by selected site observation.
16. With necessary assistance and review from installing contractors, write the functional performance test procedures for equipment and systems. This may include energy management control system trending, stand-alone datalogger monitoring or manual functional testing. Submit to CM for review, and for approval if required.
17. Analyze any functional performance trend logs and monitoring data to verify performance.
18. Coordinate, witness and approve manual functional performance tests performed by installing contractors. Coordinate retesting as necessary until satisfactory performance is achieved. Perform actual functional testing without contractors on equipment so specified in Sections 15997 and 16997.
19. Maintain a master deficiency and resolution log and a separate testing record. Provide the CM with written progress reports and test results with recommended actions.
20. Review equipment warranties to ensure that the Owner's responsibilities are clearly defined.
21. Oversee and approve the training of the Owner's operating personnel.
22. Review and approve the preparation of the O&M manuals.
23. Provide a final commissioning report (as described in this section).
24. Develop a systems manual per ASHRAE HVAC Commissioning Guideline 1-1996.

Warranty Period

25. Coordinate and supervise required seasonal or deferred testing and deficiency corrections.
26. Return to the site at 10 months into the 12 month warranty period and review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal commissioning. Also interview facility staff and identify problems or concerns they have operating the building as originally intended. Make suggestions for improvements and for recording these changes in the O&M manuals. Identify areas that may come under warranty or under the original construction contract. Assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.

E. General Contractor (GC)

Construction and Acceptance Phase

1. Facilitate the coordination of the commissioning work by the CA, and with the GC and CA ensure that commissioning activities are being scheduled into the master schedule.
2. Include the cost of commissioning in the total contract price.
3. Furnish a copy of all construction documents, addenda, change orders and approved submittals and shop drawings related to commissioned equipment to the CA.
4. In each purchase order or subcontract written, include requirements for submittal data, O&M data, commissioning tasks and training.
5. Ensure that all Subs execute their commissioning responsibilities according to the Contract Documents and schedule.
6. A representative shall attend a commissioning scoping meeting and other necessary meetings scheduled by the CA to facilitate the Cx process.
7. Coordinate the training of owner personnel.

8. Prepare O&M manuals, according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

Warranty Period

9. Ensure that Subs execute seasonal or deferred functional performance testing, witnessed by the CA, according to the specifications.
10. Ensure that Subs correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

F. Equipment Suppliers

1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.
2. Assist in equipment testing per agreements with Subs.
3. Include all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to these Contract Documents in the base bid price to the Contractor, except for stand-alone datalogging equipment that may be used by the CA.
4. Through the contractors they supply products to, analyze specified products and verify that the designer has specified the newest most updated equipment reasonable for this project's scope and budget.
5. Provide information requested by CA regarding equipment sequence of operation and testing procedures.
6. Review test procedures for equipment installed by factory representatives.

1.5 DEFINITIONS

A. Acceptance Phase - phase of construction after startup and initial checkout when functional performance tests, O&M documentation review and training occurs.

B. Approval - acceptance that a piece of equipment or system has been properly installed and is functioning in the tested modes according to the Contract Documents.

C. Architect / Engineer (A/E) - the prime consultant (architect) and sub-consultants who comprise the design team, generally the HVAC mechanical designer/engineer and the electrical designer/engineer.

D. Basis of Design - The basis of design is the documentation of the primary thought processes and assumptions behind design decisions that were made to meet the design intent. The basis of design describes the systems, components, conditions and methods chosen to meet the intent. Some reiterating of the design intent may be included.

E. Commissioning authority (CA) - an independent agent, not otherwise associated with the A/E team members or the Contractor, though he/she may be hired as a subcontractor to them. The CA directs and coordinates the day-to-day commissioning activities. The CA does not take an oversight role like the CM. The CA is part of the Construction Manager (CM) team or shall report directly to the CM.

F. Commissioning Plan - an overall plan, developed before or after bidding, that provides the structure, schedule and coordination planning for the commissioning process.

G. Contract Documents - the documents binding on parties involved in the construction of this project (drawings, specifications, change orders, amendments, contracts, *Cx Plan*, etc.).

H. Contractor - the general contractor or authorized representative.

I. Control system - the central building energy management control system.

J. Datalogging - monitoring flows, currents, status, pressures, etc. of equipment using stand-alone dataloggers separate from the control system.

K. Deferred Functional Tests - FTs that are performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions that disallow the test from being performed.

L. Deficiency - a condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents (that is, does not perform properly or is not complying with the design intent).

M. Design Intent - a dynamic document that provides the explanation of the ideas, concepts and criteria that are considered to be very important to the owner. It is initially the outcome of the programming and conceptual design phases.

N. Design Narrative or Design Documentation - sections of either the Design Intent or Basis of Design.

O. Factory Testing - testing of equipment on-site or at the factory by factory personnel with an Owner's representative present.

P. Functional Performance Test (FT) - test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) is not functional testing, in the commissioning sense of the word. TAB's primary work is setting up the system flows and pressures as specified, while functional testing is verifying that which has already been set up. The commissioning authority develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is usually performed by the installing contractor or vendor. FTs are performed after prefunctional checklists and startup are complete.

Q. General Contractor (GC) - the prime contractor for this project. Generally refers to all the GC's subcontractors as well. Also referred to as the Contractor, in some contexts.

R. Indirect Indicators - indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100% closed.

S. Manual Test - using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").

T. Monitoring - the recording of parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of control systems.

U. Non-Compliance - see Deficiency.

V. Non-Conformance - see Deficiency.

W. Over-written Value - writing over a sensor value in the control system to see the response of a system (e.g., changing the outside air temperature value from 50F to 75F to verify economizer operation). See also "Simulated Signal."

X. Owner-Contracted Tests - tests paid for by the Owner outside the GC's contract and for which the CA does not oversee. These tests will not be repeated during functional tests if properly documented.

Y. Phased Commissioning - commissioning that is completed in phases (by floors, for example) due to the size of the structure or other scheduling issues, in order minimize the total construction time.

Z. Project Manager (PM) - the contracting and managing authority for the owner over the design and/or construction of the project, a staff position.

AA. Sampling. - functionally testing only a fraction of the total number of identical or near identical pieces of equipment. Refer to Section 17100, Part 3.6, F for details.

BB. Seasonal Performance Tests - FT that are deferred until the system(s) will experience conditions closer to their design conditions.

CC. Simulated Condition - condition that is created for the purpose of testing the response of a system (e.g., applying a hair blower to a space sensor to see the response in a VAV box).

DD. Simulated Signal - disconnecting a sensor and using a signal generator to send an amperage, resistance or pressure to the transducer and DDC system to simulate a sensor value.

EE. Specifications - the construction specifications of the Contract Documents.

FF. Startup - the initial starting or activating of dynamic equipment, including executing prefunctional checklists.

GG. Subs - the subcontractors to the GC who provide and install building components and systems.

HH. Test Procedures - the step-by-step process which must be executed to fulfill the test requirements. The test procedures are developed by the CA.

II. Test Requirements - requirements specifying what modes and functions, etc. shall be tested. The test requirements are not the detailed test procedures. The test requirements are specified in the Contract Documents (Sections 15997; 16997, etc.).

JJ. Trending - monitoring using the building control system.

KK. Vendor - supplier of equipment.

LL. Warranty Period - warranty period for entire project, including equipment components. Warranty begins at Substantial Completion and extends for at least one year, unless specifically noted otherwise in the Contract Documents and accepted submittals.

1.6 SYSTEMS TO BE COMMISSIONED

A. The following systems will be commissioned in this project.

Equipment and System	Functional Test Requirements Specified In:	Equipment and System	Functional Test Requirements Specified In:
Packaged units (AC and HP)	23 81 03		

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. All standard testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the Division contractor for the equipment being tested. For example, the mechanical contractor of Division 15 shall ultimately be responsible for all standard testing equipment for the HVAC system and controls system in Division 15, except for equipment specific to and used by TAB in their commissioning responsibilities. Two-way radios shall be provided by the Division Controller.

B. Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Contractor and left on site, except for stand-alone datalogging equipment that may be used by the CA.

C. Datalogging equipment and software required to test equipment will be provided by the CA, but shall not become the property of the Owner.

D. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the *Specifications.* If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

E. Refer to Section 23 08 00, Part 3.6 E for details regarding equipment that may be required to simulate required test conditions.

PART 3 - EXECUTION

3.1 3.1 MEETINGS

A. Miscellaneous Meetings. Other meetings will be planned and conducted by the CA as construction progresses. These meetings will cover coordination, deficiency resolution and planning issues with particular Subs. The CA will plan these meetings and will minimize unnecessary time being spent by Subs. For large projects, these meetings may be held monthly, until the final 3 months of construction when they may be held as frequently as one per week.

3.2 REPORTING

A. The CA will regularly communicate with all members of the commissioning team, keeping them apprised of commissioning progress and scheduling changes through memos, progress reports, etc.

B. Testing or review approvals and non-conformance and deficiency reports are made regularly with the review and testing as described in later sections.

3.3 START-UP AND INITIAL CHECKOUT

A. The following procedures apply to all equipment to be commissioned, according to Section 1.7, Systems to be Commissioned. Some systems that are not comprised so much of actual dynamic machinery, e.g., electrical system power quality, may have very simplified PCs and startup.

B. Sensor and Actuator Calibration.

1. All field-installed temperature, relative humidity, CO, CO_2 and pressure sensors and gages, and all actuators (dampers and valves) on all equipment shall be calibrated using the methods described below. Alternate methods may be used, if approved by the Owner before-hand. All test instruments shall have had a certified calibration within the last 12 months. Sensors installed *in* the unit at the factory with calibration certification provided need not be field calibrated.
2. All procedures used shall be fully documented on the prefunctional checklists or other suitable forms, clearly referencing the procedures followed and written documentation of initial, intermediate and final results.
3. Sensor Calibration Methods
   a. All Sensors. Verify that all sensor locations are appropriate and away from causes of erratic operation. Verify that sensors with shielded cable, are grounded only at one end. For sensor pairs that are used to determine a temperature or pressure difference, make sure they are reading within 0.2°F of each other for temperature and within a tolerance equal to 2% of the reading, of each other, for pressure. Tolerances for critical applications may be tighter.
   b. Sensors Without Transmitters--Standard Application. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or building automation system (BAS)) is within the tolerances in the table below of the instrument-measured value. If not, install offset in BAS, calibrate or replace sensor.
   c. Sensors With Transmitters--Standard Application. Disconnect sensor. Connect a signal generator in place of sensor. Connect ammeter in series between transmitter and BAS control panel. Using manufacturer's resistance-temperature data, simulate minimum desired temperature. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the BAS. Record all values and recalibrate controller as necessary to conform with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction. Reconnect sensor. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or building automation system (BAS)) is within the tolerances in the table below of the instrument-measured value. If not, replace sensor and repeat. For pressure sensors, perform a similar process with a suitable signal generator.
   d. Critical Applications. For critical applications (process, manufacturing, etc.) more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.

Tolerances, Standard Applications

Sensor	Required Tolerance (+/-)	Sensor	Required Tolerance (+/-)
Cooling coil, chilled and condenser water temps	0.4F	Flow rates, water	4% of design
		Relative humidity	4% of design
AHU wet bulb or dew point	2.0F	Combustion flue temps	5.0F
Hot water coil and boiler water temp	1.5F	Oxygen or CO_2 monitor	0.1 % pts
Outside air, space air, duct air temps	0.4F	CO monitor	0.01 % pts
Watthour, voltage & amperage	1% of design	Natural gas and oil flow rate	1% of design
Pressures, air, water and gas	3% of design	Steam flow rate	3% of design
Flow rates, air	10% of design	Barometric pressure	0.1 in. of Hg

4. Valve and Damper Stroke Setup and Check
   a. EMS Readout. For all valve and damper actuator positions checked, verify the actual position against the BAS readout.

b. Set pumps or fans to normal operating mode. Command valve or damper closed, visually verify that valve or damper is closed and adjust output zero signal as required. Command valve or damper open, verify position is full open and adjust output signal as required. Command valve or damper to a few intermediate positions. If actual valve or damper position doesn't reasonably correspond, replace actuator or add pilot positioner (for pneumatics).

C. Execution of Prefunctional Checklists and Startup.
1. Four weeks prior to startup, the Subs and vendors schedule startup and checkout with the CM, GC and CA. The performance of the prefunctional checklists, startup and checkout are directed and executed by the Sub or vendor. When checking off prefunctional checklists, signatures may be required of other Subs for verification of completion of their work.
2. The CA shall observe, at minimum, the procedures for each piece of primary equipment, unless there are multiple units, (in which case a sampling strategy may be used as approved by the CM). In no case will the number of units witnessed be less than four on any one building, nor less than 20% of the total number of identical or very similar units.
3. For lower-level components of equipment, (e.g., VAV boxes, sensors, controllers), the CA shall observe a sampling of the prefunctional and start-up procedures. The sampling procedures are identified in the commissioning plan.
4. The Subs and vendors shall execute startup and provide the CA with a signed and dated copy of the completed start-up and prefunctional tests and checklists.
5. Only individuals that have direct knowledge and witnessed that a line item task on the prefunctional checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.

D. Deficiencies, Non-Conformance and Approval in Checklists and Startup.
1. The Subs shall clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies are provided to the CA within two days of test completion.
2. The CA reviews the report and submits either a non-compliance report or an approval form to the Sub or CM. The CA shall work with the Subs and vendors to correct and retest deficiencies or uncompleted items. The CA will involve the CM and others as necessary. The installing Subs or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CA as soon as outstanding items have been corrected and resubmit an updated start-up report and a Statement of Correction on the original non-compliance report. When satisfactorily completed, the CA recommends approval of the execution of the checklists and startup of each system to the CM using a standard form.
3. Items left incomplete, which later cause deficiencies or delays during functional testing may result in backcharges to the responsible party. Refer to Part 3.7 herein for details.

3.4 FUNCTIONAL PERFORMANCE TESTING

A. This sub-section applies to all commissioning functional testing for all divisions.

B. The general list of equipment to be commissioned is found in Section 23 08 00.

C. Objectives and Scope. The objective of functional performance testing is to demonstrate that each system is operating according to the documented design intent and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems.
1. In general, each system should be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load) where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to such

modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc. shall also be tested

D. Development of Test Procedures. Before test procedures are written, the CA shall obtain all requested documentation and a current list of change orders affecting equipment or systems, including an updated points list, program code, control sequences and parameters. The CA shall develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Each Sub or vendor responsible to execute a test, shall provide limited assistance to the CA in developing the procedures review (answering questions about equipment, operation, sequences, etc.). Prior to execution, the CA shall provide a copy of the test procedures to the Sub(s) who shall review the tests for feasibility, safety, equipment and warranty protection. The CA may submit the tests to the A/E for review, if requested.

1. The CA shall review owner-contracted, factory testing or required owner acceptance tests which the CA is not responsible to oversee, including documentation format, and shall determine what further testing or format changes may be required to comply with the *Specifications*. Redundancy of testing shall be minimized.
2. The purpose of any given specific test is to verify and document compliance with the stated criteria of acceptance given on the test form.

E. Test Methods.

1. Functional performance testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the performance and analyzing the results using the control system's trend log capabilities or by stand-alone dataloggers.
2. Simulated Conditions. Simulating conditions (not by an overwritten value) shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
3. Altering Setpoints. Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the AC compressor lockout work at an outside air temperature below 55F, when the outside air temperature is above 55F, temporarily change the lockout setpoint to be 2F above the current outside air temperature.
4. Indirect Indicators. Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification is completed during prefunctional testing.
5. Setup. Each function and test shall be performed under conditions that simulate actual conditions as close as is practically possible. The Sub executing the test shall provide all necessary materials, system modifications, etc. to produce the necessary flows, pressures, temperatures, etc. necessary to execute the test according to the specified conditions. At completion of the test, the Sub shall return all affected building equipment and systems, due to these temporary modifications, to their pre-test condition.

F. Coordination and Scheduling. The Subs shall provide sufficient notice to the CA regarding their completion schedule for the prefunctional checklists and startup of all equipment and systems. The CA will schedule functional tests through the CM, GC and affected Subs. The CA shall direct, witness and document the functional testing of all equipment and systems. The Subs shall execute the tests.

1. In general, functional testing is conducted after prefunctional testing and startup has been satisfactorily completed. The control system is sufficiently tested and approved by the CA before it is used for TAB or to verify performance of other components or systems. The air balancing and water balancing is completed and debugged before functional testing of air-related or water-related equipment or systems. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.

3.5 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS

A. Documentation. The CA shall witness and document the results of all functional performance tests using the specific procedural forms developed for that purpose. Prior to testing, these forms are provided to the CM for review and approval and to the Subs for review. The CA will include the filled out forms in the O&M manuals.

B. Non-Conformance.

1. The CA will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues shall be noted and reported to the CM on a standard non-compliance form.
2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CA. In such cases the deficiency and resolution will be documented on the procedure form.
3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the CM.
4. As tests progress and a deficiency is identified, the CA discusses the issue with the executing contractor.
    a. When there is no dispute on the deficiency and the Sub accepts responsibility to correct it:
        1) The CA documents the deficiency and the Sub's response and intentions and they go on to another test or sequence. After the day's work, the CA submits the non-compliance reports to the CM for signature, if required. A copy is provided to the Sub and CA. The Sub corrects the deficiency, signs the statement of correction at the bottom of the non-compliance form certifying that the equipment is ready to be retested and sends it back to the CA.
        2) The CA reschedules the test and the test is repeated.
    b. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:
        1) The deficiency shall be documented on the non-compliance form with the Sub's response and a copy given to the CM and to the Sub representative assumed to be responsible.
        2) Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the Project Manager.
        3) The CA documents the resolution process.
        4) Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, signs the statement of correction on the non-compliance form and provides it to the CA. The CA reschedules the test and the test is repeated until satisfactory performance is achieved.
5. Cost of Retesting.
    a. The cost for the *Sub* to retest a prefunctional or functional test, if they are responsible for the deficiency, shall be theirs. If they are not responsible, any cost recovery for retesting costs shall be negotiated with the GC.
    b. For a deficiency identified, not related to any prefunctional checklist or start-up fault, the following shall apply: The CA and CM will direct the retesting of the equipment once at no "charge" to the GC for their time. However, the CA's and CM's time for a second retest will be charged to the GC, who may choose to recover costs from the responsible Sub.
    c. The time for the CA and CM to direct any retesting required because a specific start-up test item, reported to have been successfully completed, but determined during functional testing to be faulty, will be backcharged to the GC, who may choose to recover costs from the party responsible for executing the faulty prefunctional test.
    d. Refer to the sampling section of Section 17100, Part 3.6 for requirements for testing and retesting identical equipment.

6. The Contractor shall respond in writing to the CA at least as often as commissioning meetings are being scheduled concerning the status of each apparent outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreements and proposals for their resolution.
7. The CA retains the original non-conformance forms until the end of the project.
8. Any required retesting by any contractor shall not be considered a justified reason for a claim of delay or for a time extension by the prime contractor.

C. Failure Due to Manufacturer Defect. If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable by the Owners Representative. In such case, the Contractor shall provide the Owner with the following:
1. Within one week of notification from the Owners Representative, the Contractor or manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided to the CM or PM within two weeks of the original notice.
2. Within two weeks of the original notification, the Contractor or manufacturer shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.
3. The Owners Representative will determine whether a replacement of all identical units or a repair is acceptable.
4. Two examples of the proposed solution will be installed by the Contractor and the Owners Representative will be allowed to test the installations for up to one week, upon which the Owners Representative will decide whether to accept the solution.
5. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

D. Approval. The CA notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test is made later after review by the CA. The CA recommends acceptance of each test to the CM using a standard form. The CM gives final approval on each test using the same form, providing a signed copy to the CA and the Contractor.

3.6 OPERATION AND MAINTENANCE MANUALS

A. Standard O&M Manuals.
1. The specific content and format requirements for the standard O&M manuals are detailed in Section 01730. Special requirements for the controls contractor and TAB contractor are found Section 15995, Part 3.6.
2. A/E Contribution. The A/E will include in the beginning of the O&M manuals a separate section describing the systems including:
   a. The design intent narrative prepared by the A/E and provided as part of the bid documents, updated to as-built status by the A/E.
   b. Simplified professionally drawn single line system diagrams on 8 ½" x 11" or 11" x 17" sheets. These shall include chillers, water system, condenser water system, heating system, supply air systems, exhaust systems and [Describe additional systems and equipment]. These shall show major pieces of equipment such as pumps, chillers, boilers, control valves, expansion tanks, coils, service valves, etc.
3. CA Review and Approval. Prior to substantial completion, the CA shall review the O&M manuals, documentation and redline as-builds *for systems that were commissioned* and [list other systems documentation that the CA should review] to verify compliance with the *Specifications.* The CA will communicate deficiencies in the manuals to the CM, PM or A/E, as requested. Upon a successful review of the corrections, the CA recommends approval and acceptance of these

sections of the O&M manuals to the CM, PM or A/E. The CA also reviews each equipment warranty and verifies that all requirements to keep the warranty valid are clearly stated. This work does not supersede the A/E's review of the O&M manuals according to the A/E's contract.

B. Commissioning Record in O&M Manuals.

1. The CA is responsible to compile, organize and index the following commissioning data by equipment into labeled, indexed and tabbed, three-ring binders and deliver it to the GC, to be included with the O&M manuals. Three copies of the manuals will be provided. The format of the manuals shall be:
   a. *Tab I-1* Commissioning Plan
   b. *Tab I-2* Final Commissioning Report (see (B.2) below)
   c. *Tab 01* System Type 1 (chiller system, packaged unit, boiler system, etc.)
      1) *Sub-Tab A* Design narrative and criteria, sequences, approvals for Equipment 1
      2) *Sub-Tab B* Startup plan and report, approvals, corrections, blank prefunctional checklists
      3) *Colored Separator Sheets*—for each equipment type (fans, pumps, chiller, etc.)
      4) *Sub-Tab C* Functional tests (completed), trending and analysis, approvals and corrections, training plan, record and approvals, blank functional test forms and a recommended recommissioning schedule.
   d. *Tab 02* System Type 2.repeat as per System 1
2. Final Report Details. The final commissioning report shall include an executive summary, list of participants and roles, brief building description, overview of commissioning and testing scope and a general description of testing and verification methods. For each piece of commissioned equipment, the report should contain the disposition of the commissioning authority regarding the adequacy of the equipment, documentation and training meeting the contract documents in the following areas: 1) Equipment meeting the equipment specifications, 2) Equipment installation, 3) Functional performance and efficiency, 4) Equipment documentation and design intent, and 5) Operator training. All outstanding non-compliance items shall be specifically listed. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. shall also be listed. Each non-compliance issue shall be referenced to the specific functional test, inspection, trend log, etc. where the deficiency is documented. The functional performance and efficiency section for each piece of equipment shall include a brief description of the verification method used (manual testing, BAS trend logs, data loggers, etc.) and include observations and conclusions from the testing.
3. Other documentation will be retained by the CA.

3.7 TRAINING OF OWNER PERSONNEL

A. The GC shall be responsible for training coordination and scheduling and ultimately for ensuring that training is completed.

B. The CA shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment.

1. The CA shall interview the facility manager and lead engineer to determine the special needs and areas where training will be most valuable. The Owner and CA shall decide how rigorous the training should be for each piece of commissioned equipment. The CA shall communicate the results to the Subs and vendors who have training responsibilities.
2. In addition to these general requirements, the specific training requirements of Owner personnel by Subs and vendors is specified in Division 23.
3. Each Sub and vendor responsible for training will submit a written training plan to the CA for review and approval prior to training. The plan will cover the following elements:
   a. Equipment (included in training)
   b. Intended audience
   c. Location of training
   d. Objectives

e. Subjects covered (description, duration of discussion, special methods, etc.)
f. Duration of training on each subject
g. Instructor for each subject
h. Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.)
i. Instructor and qualifications

4. For the primary HVAC equipment, the Controls Contractor shall provide a short discussion of the control of the equipment during the mechanical or electrical training conducted by others.
5. The CA develops an overall training plan and coordinates and schedules, with the CM and GC, the overall training for the commissioned systems. The CA develops criteria for determining that the training was satisfactorily completed, including attending some of the training, etc. The CA recommends approval of the training to the CM using a standard form. The CM also signs the approval form.
6. At one of the training sessions, the CA presents a ____ hour presentation discussing the use of the blank functional test forms for re-commissioning equipment.
7. The mechanical design engineer shall at the first training session present the overall system design concept and the design concept of each equipment section. This presentation shall be _____ hours in length and include a review of all systems using the simplified system schematics (one-line drawings) including chilled water systems, condenser water or heat rejection systems, heating systems, fuel oil and gas supply systems, supply air systems, exhaust system and outside air strategies.

3.8 DEFERRED TESTING

A. Unforeseen Deferred Tests. If any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklists and functional testing may be delayed upon approval of the PM. These tests will be conducted in the same manner as the seasonal tests as soon as possible. Services of necessary parties will be negotiated.

B. Seasonal Testing. During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's design) specified in Section 15997 shall be completed as part of this contract. The CA shall coordinate this activity. Tests will be executed, documented and deficiencies corrected by the appropriate Subs, with facilities staff and the CA witnessing. Any final adjustments to the O&M manuals and as-builds due to the testing will be made.

3.9 WRITTEN WORK PRODUCTS

A. The commissioning process generates a number of written work products described in various parts of the *Specifications.* The *Commissioning Plan—Construction Phase,* lists all the formal written work products, describes briefly their contents, who is responsible to create them, their due dates, who receives and approves them and the location of the specification to create them. In summary, the written products are:

	Product	Developed By
1.	Final commissioning plan	CA
2.	Meeting minutes	CA
3.	Commissioning schedules	CA with GC and CM
4.	Equipment documentation submittals	Subs
5.	Sequence clarifications	Subs and A/E as needed
6.	Startup and initial checkout plan	Subs and CA (compilation of existing documents)
7.	Startup and initial checkout forms filled out	Subs
8.	Final TAB report	TAB
9.	Issues log (deficiencies)	CA
10.	Commissioning Progress Record	CA

11.	Deficiency reports	CA
12.	Functional test forms	CA
13.	Filled out functional tests	CA
14.	O&M manuals	Subs
16.	Overall training plan	CA and CM
17.	Specific training agendas	Subs
18.	Final commissioning report	CA
19.	Misc. approvals	CA

END OF SECTION 23 08 00

SECTION 23 11 23

FACILITY NATURAL GAS PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section describes fuel gas piping and associated accessories for piping within the building.

1.2 SUMMARY

A. This section includes the following materials and methods.
   1. Natural Gas Piping

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. The General Conditions of the Contract, Supplementary Conditions and General Requirements are a part of the Project Specification and shall be used in conjunction with this Division as a part of the Contract Documents. Consult them for further instructions pertaining to this work. Contractors shall be responsible for and be governed by all requirements thereunder.

B. Related Sections:

1.	Common Work Results for HVAC Systems	Section 23 05 00
2.	Facility Natural Gas Piping	Section 23 11 23

1.4 QUALITY ASSURANCE

A. The gas piping components and installation shall comply with ANSI Z223.1, "National Fuel Gas Code”.

B. Provide components listed in FM's "Fire Protection Approval Guide" if products are specified to be FM approved.

C. Provide components listed in UL's "Gas and Oil Equipment Directory" if products are specified to be UL listed.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Fuel gas specialties and accessories.

B. Provide shop drawings for fuel gas piping.

C. Provide copies of all field test reports and indicate and interpret the test results to show compliance with the Contract Documents.

1.6 PROJECT CONDITIONS

A. According to the local utility company, the building side gas pressure is 0.5 psig.

1.7 COORDINATION

A. Do not interrupt existing utilities serving facilities occupied by the Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Owner not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Owner's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Appliance Connector Valves:
   1. Brass Craft
   2. Conbraco Industries
   3. Mueller
   4. State Metals
   5. Watts Industries

B. Gas Valves:
   1. Crane
   2. Grinnell
   3. Jomar
   4. McDonald
   5. Milwaukee Valve
   6. Mueller
   7. Nibco
   8. Red-White
   9. Watts Industries

2.2 PIPING MATERIALS

A. Fuel Gas Piping, up to 2 psig: Use the following:
   1. ½" to 4": steel pipe, malleable-iron threaded fittings, and threaded joints.

B. Fuel piping up to 2 psig and 4" and smaller shall be ASTM A 53; Grade B; Schedule 40; black steel pipe with malleable iron threaded fittings conforming to ASME B16.3, Class 150, standard pattern, and threaded ends according to ASME B1.20.1.

2.3 PIPING SPECIALTIES

A. Provide copper alloy flexible fuel gas connectors conforming to ANSI Z21.24.

B. Provide convenience outlet and matching plug connector quick disconnect devices conforming to ANSI Z21.41.

2.4 SPECIALTY VALVES

A. Valves 2” and smaller shall have threaded ends conforming to ASMEB1.20.1 for pipe threads.

B. Valves 2 ½” and larger shall have flanged ends conforming to ASME B16.5 for steel flanges.

C. Appliance connector valves shall conform to ANSI Z21.15.

D. Gas stops shall be plug type bronze body with bronze plug and flat or square head or ball type with chrome-plated brass ball.

E. Gas valves 2” and smaller shall be ASME B16.33 bronze body and 125-psig pressure rating.

F. Gas valves 2 ½” and larger shall be ASME B16.38 and MSS SP-78 cast-iron, lubricated plug valves, with 125-psig pressure rating.

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

A. Provide appliance connector valve or gas stop for appliance shutoff valves for pressures of 0.5 psig or less.

B. Provide gas stop or gas valve for appliance shutoff valves for pressures of 0.5 to 2 psig.

C. Provide gas valve for appliance shutoff valves for pressures 2 to 5 psig.

D. Provide gas valve for shut off valve in piping 2” and smaller.

E. Provide plug valve for shut off in piping 2 ½” and larger.

3.2 PIPING INSTALLATION

A. Provide drip leg at points where condensate may collect including outlets of service meters. Locate where readily accessible for cleaning and emptying. Do not install where condensate would be subject to freezing.
   1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum-length nipple of 3 pipe diameters, but not less than 3 inches long, and same size as connected pipe. Install with space between bottom of drip and floor for removal of plug or cap.

B. Install fuel gas piping at uniform grade of 0.1 percent slope upward toward risers.

C. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

D. Connect branch piping from top or side of horizontal piping.

E. Install unions in pipes 2” and smaller, adjacent to each valve, at final connection to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.

F. Install flanges on valves, specialties, and equipment having 2 ½” and larger connections.

G. Install vent piping for gas pressure regulators and gas trains, extend outside building, and vent to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end.

H. Inspect, test, and purge piping according to ANSI Z223.1, Part 4 "Inspection, Testing, and Purging," and requirements of authorities having jurisdiction.

I. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.

J. Report test results promptly and in writing to Owner and authorities having jurisdiction.

K. Verify capacities and pressure ratings of valves, and specialties.

L. Verify correct pressure settings for pressure regulators.

M. Verify that specified piping tests are complete.

N. Adjust controls and safety devices. Replace damaged and malfunctioning controls and safety devices.

END OF SECTION 23 11 23

SECTION 23 31 00

HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section describes the fabrication and installation of material and equipment associated with the air distribution system.

1.2 SUMMARY

A. This section includes the following materials and methods.
   1. Ductwork

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. The General Conditions of the Contract, Supplementary Conditions and General Requirements are a part of the Project Specification and shall be used in conjunction with this Division as a part of the Contract Documents. Consult them for further instructions pertaining to this work. Contractors shall be responsible for and be governed by all requirements thereunder.

B. Related Sections:

1.	Common Work Results for HVAC Systems	Section 23 05 00
2.	Testing Adjusting and Balancing	Section 23 05 93
3.	HVAC Insulation	Section 23 07 00
4.	HVAC Ducts and Casings	Section 23 31 00
5.	Air Duct Accessories	Section 23 33 00
6.	Packaged Outdoor HVAC Equipment	Section 23 75 00

1.4 QUALITY ASSURANCE

A. The air distribution system's construction and installation shall meet the requirements of any applicable codes and standards listed below:
   1. National Fire Protection Association
      a. NFPA 45, Fire Protection for Laboratories, 1991
      b. NFPA 54, National Fuel Gas Code, 1992
      c. NFPA 90A, Installation of A/C and Vent Systems, 1999
      d. NFPA 90B, Installation of Warm Air Heating and A/C Systems, 1999
      e. NFPA 91, Installation of Exhaust Systems for Air Conveying of Materials, 1992
      f. NFPA 92A, Smoke Control Systems, 1993
      g. NFPA 92B, Smoke Management Systems in Malls, Atria, Large Areas, 1991
      h. NFPA 96, Ventilation Control and Fire Protection of Commercial Cooking Operations, 1994
      i. NFPA 101, Life Safety Code, 1994
      j. NFPA 204M, Smoke and Heat Venting, 1991
      k. NFPA 211, Chimneys, Fireplaces, and Venting Systems, 1992
   2. SMACNA HVAC Duct Construction Standards, Metal and Flexible, 2nd Edition, 1995

3. SMACNA Fibrous Glass Duct Construction Standards, 1992
4. Air Diffusion Council (ADC) Test Code 1062 and ASHRAE Test Standard 70-1991 for outlets and inlets.
5. Air Movement and Control Association (AMCA) 500- Test Methods for Louvers, Dampers, and Shutters.
6.

1.5 SUBMITTALS

A. Submit the manufacturer's technical product and performance data for the following:
1. Factory-fabricated ductwork
2. Duct sealant and fire stop materials
3. Submit fabric duct manufacturer's drawings indicating size and placement of dispersion units, and mounting instructions.

1.6 ENVIRONMENTAL AIR DUCT CONSTRUCTION STANDARDS

A. All ducts shall be constructed and installed in accordance with SMACNA HVAC Duct Construction Standards for the pressure classes specified below.
1. The proprietary TDC and TDF formed-on duct connector systems may be used provided they are limited to ductwork of + 2" w.g. or lower pressure class, Seal Class B, and a maximum dimension of 42" or less. All corners shall have sealant back-up plates.
2. "Ductmate" or WDCI proprietary connector systems are acceptable provided the type of joint and the maximum joint spacing for various gages and pressure classes conform to the SMACNA Duct Construction Standards Manual."
3. All longitudinal seams shall be Pittsburgh Lock or better. "Snaplock" is not acceptable.
4. The Contractor will be required to replace all ductwork not in conformance with this specification.

B. Leakage criteria shall be as follows:
1. Constant Volume Systems:
   a. Supply ductwork at 0-2" w.g.
      1) Allowable Leakage: 2% of design cfm
   b. Supply ductwork at 3" w.g. or higher
      1) Allowable Leakage: 1% of design cfm
   c. Return ductwork:
      1) Allowable Leakage: 2% of design cfm

C. Duct sealing shall be per construction and installation standards published in the SMACNA HVAC Duct Construction Standards as follows:

DUCT SEALING REQUIREMENTS

Seal Class	Sealing Required
A	All transverse joints, longitudinal seams, and duct wall penetrations, up to 10" w.g. pressure class

1.7 SOUND CRITERIA

A. All equipment and material furnished under this section shall be selected so that required NC sound levels in various spaces are not exceeded. Attenuation by ceilings, duct liner, and room absorption may be taken into account when making fan, terminal unit, and air distribution selections. Refer to the latest edition of the ASHRAE Applications Handbook for further information.

B. Provide sufficient submittal data for terminal units, sound traps, duct liner, and air distribution devices to verify required space sound levels will not be exceeded.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Factory Fabricated Ductwork:
1. Graco
2. Hercules
3. Metco
4. Norlock
5. Semco
6. SPOT
7. McGill Airflow

B. Duct Liner:
1. CertainTeed (ToughGard)
2. Knauf type E-M
3. Owens-Corning (Aeroflex)
4. Schuller (Permacote Linacoustic).

C. Duct Sealant:
1. Chicago Mastic Corp.
2. Foster
3. Hardcast
4. SOLVseal
5. Tough Bond
6. McGill Airflow

2.2 SHEET METAL DUCTWORK

A. All sheet metal used for duct and plenum construction shall be G-90 coated galvanized steel of lock forming quality, conforming to ASTM A653 and ASTM A924.

B. At installer's option, shop fabricated duct and fittings may be provided in lieu of factory-fabricated duct and fittings. All factory and field fabricated ductwork shall meet the construction criteria established below.

C. Factory-fabricated, Low-pressure Round Ductwork (-1" to +2" w.g., Seal Class A):
1. Round ductwork shall be spiral seam (Type RL-1) for sizes 3" through 12", spiral seam (Type RL-1) for 14" through 78", and rolled longitudinal butt welded seam (Type RL-4) construction for sizes 79" and larger.
2. Elbows shall have a centerline radius of 1.5 times the duct diameter.
   a. 10” and smaller shall be one-piece construction for 90-degree and 45-degree elbows.
   b. Over 10” shall be segmented with welded circumferential joint or standing seam construction.
3. Transverse joints shall be a beaded interior sleeve joint.
4. All round ductwork and fittings shall be constructed to be suitable for use on systems with positive static pressures up to 2" w.g.

2.3 DUCT LINER

1. Provide liner as indicated in table below or as listed in the Project Drawings. All duct sizes shown on drawings are clear internal dimensions and do not include liner.

System	Thickness	Material
Exposed Rectangular Supply	1”	Flat board
Exposed Round Supply	1”	Round board
Concealed Rectangular Supply	1”	Flat board
Concealed Round Supply	1”	Round board
Exposed Rectangular Return	----	Flat board
Exposed Round Return	----	Round board
Concealed Rectangular Return	----	Flat board
Concealed Round Return	----	Round board

B. Material:

1. All liner material shall comply with the requirements of NFPA 90A and 90B, UL 181 Class 1, ASTM C1071, and the Materials Standard of the North American Insulation Manufacturer's Association (NAIMA); Type 200, Flame Spread 25 max. and Smoke Development 50 max.
2. All liner material shall not absorb more than 1% moisture when tested per ASTM C1104.
3. All liner material shall not cause corrosion of duct material (aluminum or galvanized steel) when tested per ASTM C665.
4. All liner material shall not breed or promote growth of fungi and/or bacteria when tested per ASTM C1071, G-21, and G-22. Coating shall include an EPA-registered anti- microbial agent.
5. Airstream surface and transverse edge shall be factory coated with a tough composite material to provide a maximum average velocity rating of 5,000 fpm or better at 250°F when tested per ASTM C1071.
6. Flat liner board shall have a nominal "k" value of 0.23 or less for 1" thick liner when tested per ASTM C518 at 75°F mean temperature. Round liner board shall have a nominal "k value of 0.23 or less for 1" thick liner when tested per ASTM C518-85 at 75°F mean temperature.
7. Flat liner board shall have a sound absorption coefficient of 0.91 or higher at 1,000 Hz for 1” thick liner when tested per ASTM C423-90 Type A mounting. Round liner board shall have a sound absorption coefficient of 1.01 or higher at 1,000 Hz for 1” thick liner when tested per ASTM C423-90 Type A mounting.
8. All liner shall be installed in accordance with manufacturer’s written installation instructions, including cut edge treatment, welded pins, pin spacing and adhesive installation. All liner shall be installed in accordance with SMACNA installation requirements.

2.4 DUCT SEALANT

A. All duct sealant shall comply with requirements of NFPA 90A and 90B, Flame Spread 25 max. and Smoke Developed 50 max. Sealant shall be UL classified as fire resistive when dry.

B. Duct joint and Seam Sealant Options:

1. Tape System: Woven fiber, 3" tape impregnated with a gypsum mineral compound using an Acrylic Copolymer adhesive to form a hard, durable seal.
2. Liquid Sealant: Polymeric rubber sealant formulated with a minimum of 70% solids and manufactured specifically for sealing joints and seams in low, medium, and high pressure ductwork.

C. Sealant used on outdoor ductwork shall be listed and approved for outdoor service.

PART 3 - EXECUTION

3.1 DUCT CONSTRUCTION AND INSTALLATION

A. All ductwork shall be fabricated and installed so that no undue vibration or noise results. Joints shall be sealed airtight using criteria established for each seal class and additional sealant and caulking shall be provided if necessary.

B. Hang rectangular ducts with strap iron attached to bottom of ducts and spaced not over 5’ center to center.

C. Square elbows shall have single-thickness turning vanes.

D. Provide all necessary manual, backdraft, and relief dampers as required for proper adjustment and control of air distribution.
   1. Provide a 45-degree entry fitting at all branches in rectangular ductwork, except where parallel flow branches are used.
   2. Manual dampers shall have rigid bearings and locking quadrants which allow no rattling. Damper rods shall be marked to indicate the relative position of the damper blade with respect to the rod.
   3. Backdraft and relief dampers shall be installed per the manufacturer's recommendations.
   4. Provide volume extractors similar to Titus AG45 set at 20° in ductwork behind sidewall supply registers.

E. Provide 1" angle collars for all exposed ducts passing through walls, ceilings, or floors. Anchor collars in position after installation is complete.

F. Provide flexible connections at inlet and discharge duct connections to in-line fans, fan coil units, and air handling equipment. Flexible connections shall be securely fastened to the duct and equipment per SMACNA Duct Construction Standards. Provide at least 1” of slack.

G. At all locations where interior of duct is visible through grilles, louvers, etc., paint interior of duct flat black.

H. Install sash lock type access panels or removable pin hinged access doors on ductwork to provide access to all parts of every automatic damper, fire and/or smoke damper, upstream and downstream of duct coils, and any other item requiring maintenance or inspection. Panels and/or doors shall be gasketed to minimize leakage. Fire damper access doors shall be painted red.

I. Transitions in ductwork shape and size shall be made with angles not exceeding 15 degrees diverging or 30 degrees converging.

J. Where vertical ducts pass through floors, supporting angles shall be rigidly attached to ducts and to the floor. Angles shall be galvanized and of approved sizes to properly support the ductwork. The supporting angles shall be placed on at least two sides of the duct.

K. Where horizontal ducts pass through walls and vertical ducts pass through floors, opening shall be filled to provide a tight seal between duct and opening. Refer to Part 2 of this section for approved fire stop materials to be used at all rated walls and floors.

L. Contractor shall not provide holes in any duct for the installation of hangers, conduits, other equipment, etc. The work of all other trades shall be coordinated before work begins.

M. Clean ductwork internally of dust and debris as it is installed. Clean external surfaces of foreign substances which might cause corrosion or deterioration. Where ductwork is to be painted clean all substances which might interfere with painting or cause paint deterioration.

N. Strip protective paper from stainless ductwork surfaces, and repair finish wherever it has been damaged.

O. A temporary cover shall be provided for ducts which when installed have not been connected to equipment, other ductwork, or air distribution devices. Temporary cover shall be plywood, corrugated cardboard backed polyethylene film, or other covering which will prevent entrance of dust and debris until connections are completed.

P. Flexible ducts shall be installed using lengths at least 4’ long, but not exceeding 8' for all connections. Flexible duct shall be suspended at intervals not exceeding 3 ft. with a 1"-wide, 22-gauge steel band. Maximum allowable sag is 1/2" per foot of spacing between supports. All connections shall be made with stainless steel duct clamp with worm gear fastener.

Q. All moisture-laden air exhaust ducts shall be constructed with longitudinal seams on the top side of the duct and shall be pitched to drain toward a grille.

3.2 SEALING OF DUCTS

A. All ducts shall be sealed as defined in Part 1 of this section. Apply duct sealant per the manufacturer’s written instructions, but at a minimum perform the following. Metal surfaces shall be clean, dry, and grease-free prior to applying sealant. Apply a heavy brushed on coat of sealant to the surface of the duct slip joint, position ducts and secure sections in place. Apply a finish heavy brushed on coat of sealant to the exterior surface covering the joint and heads of lock joint screws. Ensure that all voids are completely filled to ensure a continuous air pressure seal.

B. Where excessive duct vibration or mechanical abuse is possible, and additional joint finish shall be applied. Apply a heavy brushed on coat of sealant to the exterior surface joint and lay a reinforcing membrane of glass fabric approximately 2” wide onto the wet sealant. Press the reinforcing membrane into the wet sealant. Apply a second heavy brushed on coat of sealant.

END OF SECTION 23 31 00

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section describes the fabrication and installation of material and equipment associated with the air distribution system.

1.2 SUMMARY

A. This section includes the following materials and methods.
   1. Duct dampers and accessories
   2. Grilles, registers, and diffusers
   3. Air filters and gauges

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. The General Conditions of the Contract, Supplementary Conditions and General Requirements are a part of the Project Specification and shall be used in conjunction with this Division as a part of the Contract Documents. Consult them for further instructions pertaining to this work. Contractors shall be responsible for and be governed by all requirements thereunder.

B. Related Sections:

1.	Common Work Results for HVAC Systems	Section 23 05 00
2.	Testing Adjusting and Balancing	Section 23 05 93
3.	HVAC Insulation	Section 23 07 00
4.	HVAC Ducts and Casings	Section 23 31 00
5.	Air Duct Accessories	Section 23 33 00
6.	HVAC Fans	Section 23 34 00

1.4 QUALITY ASSURANCE

A. The air distribution system's construction and installation shall meet the requirements of any applicable codes and standards listed below:
   1. National Fire Protection Association
      a. NFPA 45, Fire Protection for Laboratories, 1991
      b. NFPA 54, National Fuel Gas Code, 1992
      c. NFPA 90A, Installation of A/C and Vent Systems, 1999
      d. NFPA 90B, Installation of Warm Air Heating and A/C Systems, 1999
      e. NFPA 91, Installation of Exhaust Systems for Air Conveying of Materials, 1992
      f. NFPA 92A, Smoke Control Systems, 1993
      g. NFPA 92B, Smoke Management Systems in Malls, Atria, Large Areas, 1991
      h. NFPA 96, Ventilation Control and Fire Protection of Commercial Cooking Operations, 1994
      i. NFPA 101, Life Safety Code, 1994
      j. NFPA 204M, Smoke and Heat Venting, 1991

k. NFPA 211, Chimneys, Fireplaces, and Venting Systems, 1992
2. SMACNA HVAC Duct Construction Standards, Metal and Flexible, 2nd Edition, 1995
3. SMACNA Fibrous Glass Duct Construction Standards, 1992
4. Air Diffusion Council (ADC) Test Code 1062 and ASHRAE Test Standard 70-1991 for outlets and inlets.
5. Air Movement and Control Association (AMCA) 500- Test Methods for Louvers, Dampers, and Shutters.

1.5 SUBMITTALS

A. Submit the manufacturer's technical product and performance data for the following:
1. Duct access doors
2. Flexible connectors
3. Flexible duct and takeoff fittings
4. Manual volume dampers
5. Backdraft and relief dampers
6. Grilles, registers, and diffusers
7. Air filters and gauges

1.6 OPERATION AND MAINTENANCE DATA

A. Submit the manufacturer’s operation and maintenance data for the following:
1. Duct access doors
2. Backdraft and relief dampers
3. Grilles, registers, and diffusers
4. Air filters and gauges

1.7 SOUND CRITERIA

A. All equipment and material furnished under this section shall be selected so that required NC sound levels in various spaces are not exceeded. Attenuation by ceilings, duct liner, and room absorption may be taken into account when making fan, terminal unit, and air distribution selections. Refer to the latest edition of the ASHRAE Applications Handbook for further information.

B. Provide sufficient submittal data for terminal units, sound traps, duct liner, and air distribution devices to verify required space sound levels will not be exceeded.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Flexible Duct:
1. Flexmaster
2. Hart & Cooley
3. Hercules (IFM)
4. Thermaflex
5. Wiremold

B. Duct Access Doors:
   1. Air Balance
   2. Cesco
   3. Duro-Dyne
   4. Nailor
   5. Ruskin
   6. McGill Airflow

C. Flexible Connectors:
   1. Ventfabrics
   2. Duro-Dyne

D. Manual Volume Dampers:
   1. Pottoroff
   2. Cesco
   3. Duro-Dyne
   4. Greenheck
   5. Louvers & Dampers
   6. Penn
   7. Ruskin
   8. Nailor
   9. United Enertech

E. Grilles, Registers, and Diffusers:
   1. Anemostat
   2. Carnes
   3. Krueger
   4. Metal Aire
   5. Nailor
   6. Titus

F. Filters and Gauges:
   1. American Air Filter
   2. Cam-Farr
   3. BLC Industries
   4. Flanders

2.2 FLEXIBLE DUCT

A. Dimensions shown on the plans are clear inside diameter.

B. Flexible duct shall comply with requirements of NFPA 90A and 90B, and UL 181 Standards as Class 1 Air Duct, Flame Spread 25 max. and Smoke Developed 50 max.

C. Flexible ducts shall have a minimum working pressure of 6" w.g. positive and 0.5" w.g. negative.

D. Flexible ducts upstream of air terminal units shall be medium-pressure type rated for 10" w.g. positive and 2" w.g. negative at 5,000 fpm.

E. Flexible ducts shall constructed of a metalized polyester inner liner supported by helical-wound, mechanically locked galvanized steel wire, insulation, and an outer vapor barrier with fiberglass reinforcing.
   1. Insulation shall be 1" or thicker, 3/4 lb. density fiberglass with a minimum "R" value of 4.0 at 75°F.

2.3 DUCT ACCESS DOORS

A. All access doors shall be fabricated to meet SMACNA HVAC Duct Construction Standards unless more stringent criteria are listed below.

B. Rectangular Duct Access Doors:
   1. Provide with double wall construction, galvanized steel inner and outer panels, die formed galvanized steel frame, 1” fiberglass insulation between double wall panels, and polyethylene gasket securely attached to access door
   2. Provide a single removable piano type hinge with steel camlock fasteners. Hinge shall extend full length of access panel. Screw fasteners are not acceptable.

C. Round Duct Access Doors:
   1. Access door construction and materials shall be the same as rectangular duct access doors. Provide a built-out flat section to accommodate access door.

D. Access panel sizes and gauges shall be as follows unless otherwise specified on drawings:

			Material Gauges		
Duct Size	Panel Size	Number of Latches	Frame	Exterior Panel	Interior Panel
6” to 8”	4”x8”	1	22	22	26
10” to 12”	8”x12”	1	22	22	26
12” to 16”	10”x16”	3	20	20	26
Over 18”	16”x24”	4	20	20	24

2.4 TURNING VANES

A. Provide single vane type, constructed from 22 gauge (min.) galvanized sheet metal.

B. Turning vanes shall be securely fastened to runners to maintain equidistant between all points on adjacent blades and provided with trailing edges to project air parallel to duct sides.

C. Provide turning vanes constructed per SMACNA HVAC Duct Construction Standards.

2.5 FLEXIBLE CONNECTIONS

A. Provide a flexible duct connection wherever ductwork connects to vibration isolated equipment.

B. Flexible connector shall be constructed of a 3” wide strip of flexible material between two 3” wide 24 gauge galvanized steel strips.

C. For interior applications the flexible material shall be constructed of a base woven fiberglass fabric with a neoprene coating. Flexible material shall have a tensile strength of 500 lbs, a tear strength of 13 lbs, and a weight of 30 ounces per square yard. Basis of design is Duro-Dyne Metal Fab with Neoprene fabric.

D. For exterior applications the flexible material shall be constructed of a base woven fiberglass fabric with a hypalon coating. Flexible material shall have a tensile strength of 250 lbs, a tear strength of 13 lbs, and a weight of 24 ounces per square yard. Basis of design is Duro-Dyne Metal Fab with Durolon fabric

2.6 MANUAL VOLUME DAMPERS

A. Rectangular manual volume dampers for low velocities (1,500 fpm or less)
   1. Provide 16 gauge galvanized steel channel frame.
   2. Provide 16 gauge galvanized steel opposed or parallel blades with ½" hex axle. Maximum blade width of 8", except single blade may be up to 12". Blades 36" and longer shall be furnished with reinforcing cone. Maximum blade length of 48".
   3. Provide 3/8” control shaft with locking quadrant.
   4. Basis of design is Ruskin MD 35.

B. Round manual volume dampers for low velocities (1,500 fpm or less)
   1. Provide single blade to 20" diameter and multi-blades above 20" diameter.
   2. Provide 20-gauge blade and frame to 12" diameter and 18-gauge blade above 12" diameter.
   3. Basis of design is Ruskin MDRS 25.

C. Rectangular manual volume dampers for medium velocities (1,500 to 4,000 fpm)
   1. Provide 16 gauge galvanized steel channel frame reinforced with corner braces.
   2. Provide airfoil opposed blade double skin galvanized steel construction with 16 gauge equivalent thickness and flexible blade seals mechanically locked to blade edge.
   3. Provide permanently lubricated stainless steel sleeve bearings mounted in frame.
   4. 1/2"-diameter control shaft with locking quadrant.
   5. Basis of design is Ruskin CD60.

2.7 GRILLES, REGISTERS, AND DIFFUSERS

A. All grilles, registers, and diffusers shall be performance tested and rated in accordance with ASHRAE Standard 70-1991 and ANSI S1.31-1980.

B. Provide grilles, registers, and diffusers of face size, neck size, and style indicated and scheduled on the Project Drawings. Provide all scheduled accessories and options from the grille, register, and diffuser manufacturer.

C. Provide all grilles, registers, and diffusers with white baked-on enamel finish, unless noted otherwise.

D. Provide all grilles, registers, and diffusers with a border style compatible with the required mounting surface. Provide grilles, registers, and diffusers that are specifically manufactured for each type of mounting surface to provide an accurate fit and adequate support. Refer to the Project Drawings and Specifications for mounting surfaces and ceiling systems.

E. Ceiling Supply Grilles:
1. Provide grilles constructed of 22 gauge aluminum.
2. Provide removable core.
3. DO NOT provide a volume dampers at neck unless specifically indicated or scheduled.
4. Provide adjustable louver face with throw pattern (1,2,3, or 4 way throw) as indicated on the Project Drawings.
5. Basis of design is Titus TDCA-AA.

F. Sidewall Supply Grilles:
1. Provide grilles constructed of 20 gauge aluminum.
2. Provide adjustable double deflection airfoil blades with ¾" spacing. Exterior blades shall be horizontal.
3. DO NOT provide a volume dampers at neck unless specifically indicated or scheduled.
4. Basis of design is Titus 272FL.

G. Perforated Ceiling Return Grilles:
1. Provide perforated steel face return grille with steel back pan.
2. Minimum free are of perforated face shall be 50% using 3/16" diameter holes at ¼" on center. Holes shall be staggered.
3. DO NOT provide a volume damper unless specifically indicated or scheduled.
4. Provide 90 degree return boot with acoustical lining as indicated on the Project Drawings.
5. Basis of design is Titus PAR.

H. Sidewall Return and Transfer Grilles:
1. Provide fixed 35 degree deflection grilles with ¾" blades spacing. Blades shall be horizontal.
2. Provide construction material as indicated on the Project Drawings.
3. DO NOT provide a volume dampers at neck unless specifically indicated or scheduled.
4. Basis of design is Titus 350 Series.

I. Exhaust Registers:
1. Provide fixed 35 degree deflection grilles with ¾" blades spacing. Blades shall be horizontal.
2. All registers components shall be constructed of aluminum.
3. DO NOT provide a volume dampers at neck unless specifically indicated or scheduled.
4. Basis of design is Titus 350FL.

2.8 FILTERS AND GAUGES

A. Type of filters and housings shall be as noted or scheduled on the drawings.

B. Dust spot and arrestance efficiencies shall be as determined per ASHRAE Test Standard 52.1.

C. Specification "F-B" Disposable Pleated Filters (Medium Efficiency):
1. Air filters shall be medium efficiency, pleated, disposable type, 2" thick. Each filter shall consist of media, media support grid and enclosing frame. The filter shall be listed by Underwriters' Laboratories as Class 2.
2. Filter media shall be lofted, non-woven cotton fabric or glass fiber. The filter media shall have an average dust spot efficiency of 25-30% and an average arrestance of 75-90%.
3. The effective filter media shall be not less than 4.6 square feet of media per 1.0 square foot of filter face area and shall contain not less than 11 pleats per linear foot. Initial resistance at 500 fpm approach velocity shall not exceed 0.30" w.g.
4. The media support shall be a welded wire grid with an effective open area of not less than 96%. The welded wire grid shall be bonded to the filter media to eliminate the possibility of media oscillation and media pull away. The media support grid shall be formed in such a manner that it effects a radial pleat design, allowing total use of filter media.

5. The enclosing frame shall be constructed of a rigid, heavy-duty, high wet-strength beverage board, with diagonal support members bonded to the air entering and air exit side of each pleat, to ensure pleat stability. The inside periphery of the enclosing frame shall be bonded to the filter pack to eliminate the possibility of air bypass.

D. Two complete sets of pre-filters shall be supplied for use during the construction and testing and balancing period. Another set of new pre-filters shall be installed after testing and balancing, total number of sets -- three.

E. Each filter bank shall have a Dwyer 2000 series, magnahelic differential pressure gauge. These gauges shall be installed to measure the differential pressure across each filter bank. Each gauge shall have a suitable range to indicate clean loading and dirty filter conditions. Provide Model A-605 air filter kit with mounting panel and accessories for each 2000 series gauge.

PART 3 - EXECUTION

3.1 CONTROL DAMPER INSTALLATION

A. Damper submittals shall be coordinated for type, quantity, and size to ensure compatibility with sheet metal design.

B. Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting. Duct openings shall measure 1/4" larger than damper dimensions and shall be square, straight, and level.

C. Individual damper sections, as well as entire multiple section assemblies, must be square and free from racking, twisting, or bending. Measure diagonally from upper corners to opposite lower corners of each damper section. Both dimensions must be within ±1/8".

D. Follow manufacturer's instructions for field installation of control dampers. Unless specifically designed for vertical blade application, dampers must be mounted with blade axis horizontal.

E. Install extended shaft or jackshaft per manufacturer's instructions. Typically, a sticker on the damper face shows recommended extended shaft location. Attach shaft on labeled side of damper to that blade.
   1. Damper blades, axles, and linkage must operate without binding. Before system operation, cycle damper after installation to assure proper operation. On multiple section assemblies, all sections must open and close simultaneously.

F. Provide a visible and accessible indication of damper position on the drive shaft end.

G. Support duct on both sides of damper to prevent sagging due to damper weight.

H. After installation of low-leakage dampers with seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.

3.2 GRILLES, REGISTERS, AND DIFFUSERS

A. Grilles, registers, and diffusers shall be installed and supported per manufacturer's recommendations and per the UBC.
   1. Ceiling-mounted air devices or services weighing less than 20 pounds shall be positively attached to the ceiling suspension main runners or to cross runners with the same carrying capacity as the main runners.
   2. Devices or services weighing 20 pounds, but not more than 56 pounds, in addition to the above, shall have two No. 12-gauge hangers connected from the device or service to the ceiling system hangers or to the structure above. These wires may be slack.
   3. Air devices or services weighing more than 56 pounds shall be supported directly from the structure above by approved hangers.
   4. Seal the neck joints on all grilles, registers and diffusers.

B. Throw patterns (directions) shall be furnished and/or adjusted to match those shown and/or scheduled on the drawings.

C. Ductwork visible behind grilles, registers, and diffusers shall be painted flat black.

D. Appropriate A_k factors shall be transmitted to the Test and Balance Contractor.

3.3 FILTERS AND GAUGES

A. Install filters and frame per manufacturer's installation instructions in locations scheduled or shown on the Project Drawings.

B. Install filter gauge across each filter bank. Mount gauge on duct or air handler in a position easily visible from floor level. Location of filters and gauges in plenums above accessible ceilings shall be labeled with an identification tag attached to the ceiling grid at each location.

C. Two sets of pre-filters may be utilized during the construction. The final (third) set shall be installed after all construction is complete, spaces served are clean, and the HVAC system is ready for "beneficial use" by the Owner or occupants.

END OF SECTION 23 33 00

SECTION 23 34 00

HVAC FANS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section describes air moving devices and associated components.

1.2 SUMMARY

A. This section includes the following materials and methods.
   1. Ceiling-mounting ventilators

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. The General Conditions of the Contract, Supplementary Conditions and General Requirements are a part of the Project Specification and shall be used in conjunction with this Division as a part of the Contract Documents. Consult them for further instructions pertaining to this work. Contractors shall be responsible for and be governed by all requirements thereunder.

B. Related Sections:

1.	Common Work Results for HVAC Systems	Section 23 05 00
2.	Testing Adjusting and Balancing	Section 23 05 93
3.	HVAC Insulation	Section 23 07 00
4.	HVAC Ducts and Casings	Section 23 31 00
5.	Air Duct Accessories	Section 23 33 00
6.	HVAC Fans	Section 23 34 00

1.4 QUALITY ASSURANCE

A. Electrical components, devices, and accessories shall be 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. Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. Motors and electrical accessories shall comply with NEMA standards.

D. Power ventilators shall comply with UL 705.

1.5 SUBMITTALS

A. Submit product and performance data for all fans used on the project 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 gauges and finishes.
5. Dampers, including housings, linkages, and operators.
6. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.
7. Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer-installed wiring and field-installed wiring.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit the manufacturer’s operation and maintenance data for all fans used in this project.

1.7 PERFORMANCE REQUIREMENTS

A. All fan ratings and performance shall based upon the project elevation.

1.8 EXTRA MATERIALS

A. Provide two extra sets of belts for each belt driven fan. The extra belt[s] shall match the installed material and shall be packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Ceiling-Mounting Ventilators:
1. Greenheck Fan Corp.
2. Penn Ventilation Companies, Inc.
3. Twin City

2.2 GENERAL REQUIRMENTS

A. All fans shall comply with AMCA Standard 301, "Method for Calculating Fan Sound Ratings From Laboratory Test Data." Fans shall be tested in accordance with AMCA Standard 300, "Test Code for Sound Rating." Fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.

B. Fan flow rate, pressure, power, air density, speed of rotation, and efficiency shall be established by factory tests and ratings in accordance with AMCA Standard 210/ASHRAE Standard 51, "Laboratory Methods of Testing Fans for Rating."

C. Provide fans that are factory fabricated and assembled, factory tested, and factory finished, with indicated capacities and characteristics.

D. All fans and shafts shall be statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower. The fan shaft shall be turned, ground, and polished steel, designed to operate at no more than 70% of the first critical speed at the top of the speed range of the fan's class.

E. Belt drives shall be rated for 150% or more of motor horsepower, factory-mounted and adjustable, with final alignment and belt adjustment made after installation.

F. Belts shall be oil-resistant, non-sparking, and non-static.

G. Fan wheel pulleys shall be adjustable pitch for use with motors through 15 hp and shall be fixed pitch for use with motors larger than 15 hp. Select pulley so that pitch adjustment is at the middle of the adjustment range at fan design conditions. Provide an OSHA approved steel belt guard with tachometer openings for the motor and fan shaft for all exposed belts.

H. Provide all shaft bearings with a median life "Rating Life" (AFBMA L_{50}) of 200,000 hours, calculated in accordance with Anti-Friction Bearing Manufacturer's Association (AFBMA) Standard 9 for ball bearings and AFBMA Standard 11 for roller bearings.

I. All three-phase fan motors 1 hp through 200 hp shall be energy-efficient type meeting EPACT 92 requirements. Reference Section 15050 for additional motor requirements. Fan motors shall be selected so that they do not operate in the service factor at total pressures ±20% from selection point.

J. Provide the following factory finishes:
   1. Sheet Metal Parts: Prime coating prior to final assembly.
   2. Exterior Surfaces: Baked-enamel finish coat after assembly.

2.3 CEILING-MOUNTING VENTILATORS

A. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.

B. Housing: Steel, lined with acoustical insulation.

C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

D. Grille: Plastic, louvered grille with flange on intake and thumbscrew attachment to fan housing.

E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

F. Accessories:
   1. Isolation: Rubber-in-shear vibration isolators.
   2. Manufacturer's standard roof jack or wall cap, and transition fittings.

2.4 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. Support units using spring isolators having a static deflection of 1 inch.
   1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.

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.

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.

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment.

D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Equipment Startup Checks:
   1. Verify that shipping, blocking, and bracing are removed.
   2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
   3. Verify that cleaning and adjusting are complete.
   4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
   5. Verify lubrication for bearings and other moving parts.
   6. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
   7. Disable automatic temperature-control operators.

B. Starting Procedures:
   1. Energize motor and adjust fan to indicated rpm.
   2. Measure and record motor voltage and amperage.

C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.

D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Shut unit down and reconnect automatic temperature-control operators.

F. Replace fan and motor pulleys as required to achieve design airflow.

G. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Lubricate bearings.

3.5 CLEANING

A. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.

B. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain power ventilators.
   1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
   2. Review data in maintenance manuals.
   3. Schedule training with Owner with at least seven days' advance notice.

END OF SECTION 23 34 00

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SECTION 23 81 03

PACKAGED ROOFTOP UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes rooftop heating and cooling units.

1.2 RELATED SECTIONS

A. The General Conditions of the Contract, Supplementary Conditions and General Requirements are a part of the Project Specification and shall be used in conjunction with this Division as a part of the Contract Documents. Consult them for further instructions pertaining to this work. Contractors shall be responsible for and be governed by all requirements thereunder.

B. Related Sections:

1.	Common Work Results for HVAC Systems	Section 23 05 00
2.	Testing Adjusting and Balancing	Section 23 05 93
3.	HVAC Insulation	Section 23 07 00
4.	HVAC Ducts and Casings	Section 23 31 00
5.	Air Duct Accessories	Section 23 33 00
6.	HVAC Fans	Section 23 34 00

1.3 SUBMITTALS

A. Provide product data including manufacturer's technical data for each model indicated, including rated capacities of selected model clearly indicated; dimensions; required clearances; shipping, installed, and operating weights; furnished specialties; accessories; and installation and startup instructions.

B. Provide shop drawings which detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.

1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.

C. Provide maintenance data for equipment to include in the maintenance manuals specified in Division 1.

D. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

B. Energy efficiency ratio shall be equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

C. Coefficient of performance shall be equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

D. Provide electrically operated components specified in this Section that are listed and labeled.
   1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
   2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

E. Comply with AGA Z223.1 for gas-fired furnace section.

F. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver rooftop units as factory-assembled units with protective crating and covering.

B. Handle rooftop units to comply with manufacturer's written rigging and installation instructions for unloading and moving to final location.

1.6 COORDINATION

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations with roof construction.

1.7 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: A written warranty, executed by the manufacturer and signed by the Contractor, agreeing to replace components that fail in materials or workmanship, within the specified warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed.
   1. Warranty Period, Compressors: Manufacturers standard, but not less than 5 years after date of Substantial Completion.
   2. Warranty Period, Heat Exchangers: Manufacturers standard, but not less than 10 years after date of Substantial Completion.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
   1. Fan Belts: One set for each belt-drive fan.
   2. Filters: Two sets of filters for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Rooftop Units, 3 to 20 Tons:
   1. Lennox
   2. Carrier
   3. Luxaire

2.2 ROOFTOP UNITS 3 to 20 TONS

A. General
   1. Outdoor, rooftop mounted, electrically controlled, heating and cooling unit utilizing a fully hermetic scroll compressor(s) for cooling duty and gas combustion for heating duty.
   2. Factory assembled, single-piece heating and cooling rooftop unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and special features required prior to field start-up.
   3. Unit shall use environmentally sound, Puron refrigerant.
   4. Unit shall be installed in accordance with the manufacturer's instructions.
   5. Unit must be selected and installed in compliance with local, state, and federal codes.

B. Quality Assurance
   1. Unit meets ASHRAE 90.1 minimum efficiency requirements.
   2. Unit shall be rated in accordance with AHRI Standards 2 10/240 and 340/360.
   3. Unit shall be designed to conform to ASHRAE 15, 2001.
   4. Unit shall be UL-tested and certified in accordance with ANSI Z2 1.47 Standards and UL-listed and certified under Canadian standards as a total package for safety requirements.
   5. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
   6. Unit casing shall be capable of withstanding 500-hour salt spray exposure per ASTM B1 17.
   7. Unit casing shall be capable of withstanding Federal Test Method Standard No. 141 (Method 6061) 5000-hour salt spray.
   8. Unit shall be designed in accordance with ISO 9001, and shall be manufactured in a facility registered by ISO 9001.
   9. Roof curb shall be designed to conform to NRCA Standards.
   10. Unit shall be subjected to a completely automated run test on the assembly line. The data for each unit will be stored at the factory, and must be available upon request.
   11. Unit shall be designed in accordance with UL Standard 1995, including tested to withstand rain.
   12. Unit shall be constructed to prevent intrusion of snow and tested to prevent snow intrusion into the control box up to 40 mph.
   13. Unit shake tested to assurance level 1, ASTM D4169 to ensure shipping reliability.
   14. High Efficient Motors listed shall meet section 313 of the Energy Independence and Security Act of 2007 (EISA 2007) Delivery, Storage, and Handling
   15. Unit shall be stored and handled per manufacturer's recommendations.
   16. Lifted by crane requires either shipping top panel or spreader bars.
   17. Unit shall only be stored or positioned in the upright position.

C. Operating Characteristics
   1. Unit shall be capable of starting and running at 115_F (46_C) ambient outdoor temperature, meeting maximum load criteria of AHRI Standard 210/240 or 340/360 at ± 10% voltage.
   2. Compressor with standard controls shall be capable of operation down to 40_F (4_C), ambient outdoor temperatures. Accessory winter start kit is necessary if mechanically cooling at ambient temperatures down to 25_F (-4_C).
   3. Unit shall discharge supply air vertically or horizontally as shown on contract drawings.
   4. Unit shall be factory configured for vertical supply & return configurations.
   5. Unit shall be field convertible from vertical to horizontal airflow on all models. No special kit required on 04-14 models. Supply duct kit required for 16 size model only.
   6. Unit shall be capable of mixed operation: vertical supply with horizontal return or horizontal supply with vertical return.

D. Electrical Requirements
   1. Main power supply voltage, phase, and frequency must match those required by the manufacturer.

E. Unit Cabinet
   1. Unit cabinet shall be constructed of galvanized steel, and shall be bonderized and coated with a prepainted baked enamel finish on all externally exposed surfaces.
   2. Unit cabinet exterior paint shall be: film thickness, (dry) 0.003 inches minimum, gloss (per ASTM D523, 60_F / 16_C): 60, Hardness: H-2H Pencil hardness.
   3. Evaporator fan compartment interior cabinet insulation shall conform to AHRI Standards 2 10/240 or 340/360 minimum exterior sweat criteria. Interior surfaces shall be insulated with a minimum 1/2-in. thick, 1 lb density, flexible fiberglass insulation, neoprene coated on the air side. Aluminum foil-faced fiberglass insulation shall be used in the gas heat compartment.
   4. Base of unit shall have a minimum of four locations for thru-the-base gas and electrical connections (factory installed or field installed), standard.
   5. Base Rail
      a. Unit shall have base rails on a minimum of 2 sides.
      b. Holes shall be provided in the base rails for rigging shackles to facilitate maneuvering and overhead rigging.
      c. Holes shall be provided in the base rail for moving the rooftop by fork truck.
      d. Base rail shall be a minimum of 16 gauge thickness.
   6. Condensate pan and connections:
      a. Shall be a sloped condensate drain pan made of a non-corrosive material.
      b. Shall comply with ASHRAE Standard 62.
      c. Shall use a 3/4” -14 NPT drain connection, possible either through the bottom or side of the drain pan. Connection shall be made per manufacturer’s recommendations.
   7. Top panel shall be a single piece top panel on 04 thru 12 sizes, two piece on 14 and 16 sizes.
   8. Gas Connections:
      a. Standard unit shall have a thru-the-base gas-line location using a raised, embossed portion of the unit basepan.
   9. Electrical Connections
      a. Standard unit shall have a thru-the-base electrical location(s) using a raised, embossed portion of the unit basepan.
   10. Component access panels (standard)
      a. Cabinet panels shall be easily removable for servicing.
      b. Unit shall have one factory installed tool-less, removable, filter access panel.
      c. Panels covering control box, indoor fan, indoor fan motor, gas components (where applicable), and compressors shall have molded composite handles.
      d. Handles shall be UV modified, composite. They shall be permanently attached, and recessed into the panel.
      e. Screws on the vertical portion of all removable access panel shall engage into heat resistant, molded composite collars.

f. Collars shall be removable and easily replaceable using manufacturer recommended parts.

F. Gas Heat
1. General
a. Heat exchanger shall be an induced draft design. Positive pressure heat exchanger designs shall not be allowed.
b. Shall incorporate a direct-spark ignition system and redundant main gas valve.
c. Gas supply pressure at the inlet to the rooftop unit gas valve must match that required by the manufacturer.
2. The heat exchanger shall be controlled by an integrated gas controller (IGC) microprocessor.
a. IGC board shall notify users of fault using an LED (light-emitting diode).
b. The LED shall be visible without removing the control box access panel.
c. IGC board shall contain algorithms that modify evaporator fan operation to prevent future cycling on high temperature limit switch.
d. Unit shall be equipped with anti-cycle protection with one short cycle on unit flame rollout switch or 4 continuous short cycles on the high temperature limit switch. Fault indication shall be made using an LED.
3. Standard Heat Exchanger construction
a. Heat exchanger shall be of the tubular-section type constructed of a minimum of 20-gauge steel coated with a nominal 1.2 mil aluminum-silicone alloy for corrosion resistance.
b. Burners shall be of the in-shot type constructed of aluminum-coated steel.
c. Burners shall incorporate orifices for rated heat output up to 2000 ft (610m) elevation. Additional accessory kits may be required for applications above 2000 ft (610m) elevation, depending on local gas supply conditions.
d. Each heat exchanger tube shall contain multiple dimples for increased heating effectiveness.
4. Induced draft combustion motor and blower
a. Shall be a direct-drive, single inlet, forward-curved centrifugal type.
b. Shall be made from steel with a corrosion-resistant finish.
c. Shall have permanently lubricated sealed bearings.
d. Shall have inherent thermal overload protection.
e. Shall have an automatic reset feature.

G. Coils
1. Standard Aluminum Fin - Copper Tube Coils:
a. Standard evaporator and condenser coils shall have aluminum lanced plate fins mechanically bonded to seamless internally grooved copper tubes with all joints brazed.
b. Evaporator coils shall be leak tested to 150 psig pressure tested to 450 psig, and qualified to UL 1995 burst test at 1775 psig.
c. Condenser coils shall be leak tested to 150 psig pressure tested to 650 psig, and qualified to UL 1995 burst test at 1980 psig.

H. Refrigerant Components
1. Refrigerant circuit shall include the following control, safety, and maintenance features:
a. Fixed orifice metering system shall prevent mal-distribution of two-phase refrigerant by including multiple fixed orifice devices in each refrigeration circuit. Each orifice is to be optimized to the coil circuit it serves.
b. Refrigerant filter drier - Solid core design.
c. Service gauge connections on suction and discharge lines.
d. Pressure gauge access through a specially designed access port in the top panel of the unit.

2. There shall be gauge line access port in the skin of the rooftop, covered by a black, removable plug.
    a. The plug shall be easy to remove and replace.
    b. When the plug is removed, the gauge access port shall enable maintenance personnel to route their pressure gauge lines.
    c. This gauge access port shall facilitate correct and accurate condenser pressure readings by enabling the reading with the compressor access panel on.
    d. The plug shall be made of a leak proof, UV-resistant, composite material.
3. Compressors
    a. Unit shall use fully hermetic, scroll compressor for each independent refrigeration circuit.
    b. Compressor motors shall be cooled by refrigerant gas passing through motor windings.
    c. Compressors shall be internally protected from high discharge temperature conditions.
    d. Compressors shall be protected from an over-temperature and over-amperage conditions by an internal, motor overload device.
    e. Compressor shall be factory mounted on rubber grommets.
    f. Compressor motors shall have internal line break thermal, current overload and high pressure differential protection.
    g. Crankcase heaters shall not be required for normal operating range, unless required by compressor manufacturer due to refrigerant charge limits.

I. Filter Section
    a. Filters access is specified in the unit cabinet section of this specification.
    b. Filters shall be held in place by a pivoting filter tray, facilitating easy removal and installation.
    c. Shall consist of factory installed, low velocity, throw-away 2-in. thick fiberglass filters.
    d. Filters shall be standard, commercially available sizes.
    e. Only one size filter per unit is allowed.

J. Evaporator Fan and Motor
1. Evaporator fan motor:
    a. Shall have permanently lubricated bearings.
    b. Shall have inherent automatic-reset thermal overload protection or circuit breaker.
    c. Shall have a maximum continuous bhp rating for continuous duty operation; no safety factors above that rating shall be required.
2. Belt-driven Evaporator Fan:
    a. Belt drive shall include an adjustable pitch motor pulley.
    b. Shall use sealed, permanently lubricated ball-bearing type.
    c. Blower fan shall be double-inlet type with forward-curved blades.
    d. Shall be constructed from steel with a corrosion resistant finish and dynamically balanced.

K. Condenser Fans and Motors
1. Condenser fan motors:
    a. Shall be a totally enclosed motor.
    b. Shall use permanently lubricated bearings.
    c. Shall have inherent thermal overload protection with an automatic reset feature.
    d. Shall use a shaft-down design on 04 to 12 and 16 models and shaft-up on 14 size with rain shield.
2. Condenser Fans:
    a. Shall be a direct-driven propeller type fan.
    b. Shall have aluminum blades riveted to corrosion-resistant steel spiders and shall be dynamically balanced.

L. Special Features Options and Accessories

1. Integrated Economizers:
    a. Integrated, gear-driven opposing modulating blade design type capable of simultaneous economizer and compressor operation.
    b. Independent modules for vertical or horizontal return configurations shall be available. Vertical return modules shall be available as a factory installed option.
    c. Damper blades shall be galvanized steel with composite gears. Plastic or composite blades on intake or return shall not be acceptable.
    d. Shall include all hardware and controls to provide free cooling with outdoor air when temperature and/or humidity are below setpoints.
    e. Shall be equipped with gear driven dampers for both the outdoor ventilation air and the return air for positive air stream control.
    f. Shall be equipped with low-leakage dampers, not to exceed 2% leakage at 1 in. wg pressure differential.
    g. Shall be capable of introducing up to 100% outdoor air.
    h. Shall be equipped with a barometric relief damper capable of relieving up to 100% return air.
    i. Shall be designed to close damper(s) during loss-of-power situations with spring return built into motor.
    j. Dry bulb outdoor air temperature sensor shall be provided as standard. Outdoor air sensor setpoint shall be adjustable and shall range from 40 to 100_F / 4 to 38_C. Additional sensor options shall be available as accessories.
    k. The economizer controller shall also provide control of an accessory power exhaust unit function. Factory set at 100%, with a range of 0% to 100%.
    l. The economizer shall maintain minimum airflow into the building during occupied period and provide design ventilation rate for full occupancy. A remote potentiometer may be used to override the damper setpoint.
    m. Dampers shall be completely closed when the unit is in the unoccupied mode.
    n. Economizer controller shall accept a 2-10 Vdc CO2 sensor input for IAQ/DCV control. In this mode, dampers shall modulate the outdoor air damper to provide ventilation based on the sensor input.
    o. Compressor lockout sensor shall open at 35_F (2_C) and close closes at 50_F (10_C).
    p. Actuator shall be direct coupled to economizer gear. No linkage arms or control rods shall be acceptable.
    q. Economizer controller shall provide indications when in free cooling mode, in the DCV mode, or the exhaust fan contact is closed.
2. Head Pressure Control Package
    a. Controller shall control coil head pressure by condenser fan speed modulation or condenser fan cycling and wind baffles.
    b. Shall consist of solid-state control and condenser coil temperature sensor to maintain condensing temperature between 90F and 110F at outdoor ambient temperatures down to -20F.
3. Flue Shield
    a. Flue shield shall provide protection from the hot sides of the gas flue hood.
4. Condenser Coil Hail Guard Assembly
    a. Shall protect against damage from hail.
    b. Shall be either hood style or louvered.
5. Unit-Mounted, Non-Fused Disconnect Switch:
    a. Switch shall be factory installed, internally mounted.
    b. National Electric Code (NEC) and UL approved non-fused switch shall provide unit power shutoff.
    c. Shall be accessible from outside the unit.
    d. Shall provide local shutdown and lockout capability.

6. Convenience Outlet:
    a. Outlet shall be powered from main line power to the rooftop unit.
    b. Outlet shall be powered from line side or load side of disconnect by installing contractor, as required by code. If outlet is powered from load side of disconnect, unit electrical ratings shall be UL certified and rated for additional outlet amperage.
    c. Outlet shall be factory installed and internally mounted with easily accessible 115-v female receptacle.
    d. Outlet shall include 15 amp GFI receptacles with independent fuse protection.
    e. Voltage required to operate convenience outlet shall be provided by a factory installed step-down transformer.
    f. Outlet shall be accessible from outside the unit.
    g. Outlet shall include a field installed "Wet in Use" cover.
7. Thru-the-Base Connectors:
    a. Kits shall provide connectors to permit gas and electrical connections to be brought to the unit through the unit basepan.
    b. Minimum of four connection locations per unit.
8. Roof Curbs (Vertical):
    a. Full perimeter roof curb with exhaust capability providing separate air streams for energy recovery from the exhaust air without supply air contamination.
    b. Formed galvanized steel with wood nailer strip and shall be capable of supporting entire unit weight.
    c. Permits installation and securing of ductwork to curb prior to mounting unit on the curb.
9. High Altitude Gas Conversion Kit:
    a. Package shall contain all the necessary hardware and instructions to convert a standard natural gas unit to operate from 2000-7000 ft (610 to 2134m) elevation with natural gas or from 0-7000 ft (90-2134m) elevation with liquefied propane.
10. Outdoor Air Enthalpy Sensor:
    a. The outdoor air enthalpy sensor shall be used to provide single enthalpy control. When used in conjunction with a return air enthalpy sensor, the unit will provide differential enthalpy control. The sensor allows the unit to determine if outside air is suitable for free cooling.
11. Smoke detectors:
    a. Shall be a Four-Wire Controller and Detector.
    b. Shall be environmental compensated with differential sensing for reliable, stable, and drift-free sensitivity.
    c. Shall use magnet-activated test/reset sensor switches.
    d. Shall have tool-less connection terminal access.
    e. Shall have a recessed momentary switch for testing and resetting the detector.
    f. Controller shall include:
        1) One set of normally open alarm initiation contacts for connection to an initiating device circuit on a fire alarm control panel.
        2) Two Form-C auxiliary alarm relays for interface with rooftop unit or other equipment.
        3) One Form-C supervision (trouble) relay to control the operation of the Trouble LED on a remote test/reset station.
        4) Capable of direct connection to two individual detector modules.
        5) Can be wired to up to 14 other duct smoke detectors for multiple fan shutdown applications
12. Winter start kit
    a. Shall contain a bypass device around the low pressure switch.
    b. Shall be required when mechanical cooling is required down to 25_F (-4_C).
    c. Shall not be required to operate on an economizer when below an outdoor ambient of 40_F (4_C).

13. Time Guard
    a. Shall prevent compressor short-cycling by providing a 5-minute delay (±2 minutes) before restarting a compressor after shutdown for any reason.
    b. One device shall be required per compressor.

M. Programmable electronic thermostat with heating setback and cooling setup with 7-day programming.
1. Operating Controls: Factory-installed microprocessor controls and monitors unit and communicates with central control processor.
2. Control Outputs: 2-stage heating, 2-stage cooling; and automatic or continuous fan operation and economizer damper operation.
3. Control Sensors: Return-air-temperature sensor, fan airflow-proving switch, dirty-filter switch, discharge-air-temperature sensor, room-temperature sensor, and night-setback-override switch.
4. Control Features: Day/occupied modes for high or low enthalpy and night/unoccupied mode.

2.3 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate capacity according to ARI 210/240, "Unitary Air-Conditioning and Air Source Heat Pump Equipment."

B. Verification of Performance: Rate capacity according to ARI 360, "Commercial and Industrial Unitary Air-Conditioning Equipment."
1. Sound Power Level Ratings: Comply with ARI 270, "Standard for Sound Rating of Outdoor Unitary Equipment."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units according to manufacturer's written instructions.

B. Install units level and plumb, maintaining manufacturer's recommended clearances.

C. Curb Support: Install roof curb on roof structure, level, according to NRCA's written installation instructions. Install and secure rooftop units on curbs and coordinate roof penetrations and flashing with roof construction.

D. Check fan-wheel rotation for correct direction without vibration and binding.

E. Adjust fan belts to proper alignment and tension.

F. Start unit according to manufacturer's written instructions. Perform starting up of refrigeration system in summer only.

G. Calibrate thermostats.

H. Adjust and check high-temperature limits.

I. Check internal isolators.

J. Check outside-air damper for proper stroke and interlock with return-air dampers.

K. Check controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.

3.2 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
   1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
   2. Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION 23 81 03

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Supporting devices for electrical components.
   2. Concrete equipment bases.
   3. Cutting and patching for electrical construction.
   4. Touchup painting.
   5. Electrical demolition.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.4 SERVING UTILITY COMPANIES

A. Serving Electric Utility is as follows:
   1. Name: KC Electric Assoc.
      Contact: Robert Rueb
      E-mail: rrueb@kcelectric.com

B. All charges and/or fees levied by the serving utility companies relative to this project shall be paid directly by the Owner.

C. Obtain and pay all fees for permits, licensing, and inspections applicable to work of Division 16.

1.5 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during construction to facilitate the electrical installations that follow.

B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work.

C. Coordinate electrical service connections to components furnished by utility company.
   1. Coordinate installation and connection of services, including provision for electricity-metering components.

2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.

PART 2 - PRODUCTS

2.1 SUPPORTING DEVICES

A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.

B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.

C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch- (14-mm-) diameter slotted holes at a maximum of 2 inches (50 mm) o.c., in webs.

D. Slotted-Steel Channel Supports: Comply with Division 5 Section "Metal Fabrications" for slotted channel framing.
   1. Channel Thickness: Selected to suit structural loading.
   2. Fittings and Accessories: Products of the same manufacturer as channel supports.

E. Nonmetallic Channel and Angle Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (203 mm) o.c., in at least one surface.
   1. Fittings and Accessories: Products of the same manufacturer as channels and angles.
   2. Fittings and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.

F. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.

G. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

H. Expansion Anchors: Carbon-steel wedge or sleeve type.

I. Toggle Bolts: All-steel springhead type.

J. Powder-Driven Threaded Studs: Heat-treated steel.

2.2 UNISTRUT FRAMES

A. Provide Unistrut frame and protective bollards for the exterior main service gear. Frame shall consist of horizontal Unistrut members mounted to vertical posts.

B. Vertical posts shall be 2-1/2” galvanized schedule 40 posts with caps, set in 6-in x 30-in deep concrete bases.

C. Bollards shall be provided as directed by Owner and Utility to protect gear from motor vehicle damage. Bollards shall be 6-foot long, 4-in diameter pipes filled with concrete, set 3-feet into concrete bases. Revise detail as required to meet Utility requirements.

2.3 TOUCHUP PAINT

A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.

B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.

B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 ELECTRICAL SUPPORTING DEVICE APPLICATION

A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.

B. Dry Locations: Steel materials.

C. Support Clamps for PVC Raceways: Click-type clamp system.

D. Selection of Supports: Comply with manufacturer's written instructions.

E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb (90-kg) design load.

3.3 SUPPORT INSTALLATION

A. Install support devices to securely and permanently fasten and support electrical components.

B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.

C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.

D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.

E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.

F. Install 1/4-inch- (6-mm-) diameter or larger threaded steel hanger rods, unless otherwise indicated.

G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch (38-mm) and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.

H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.

I. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches (610 mm) from the box.

J. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.

K. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

L. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
   1. Wood: Fasten with wood screws or screw-type nails.
   2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
   3. New Concrete: Concrete inserts with machine screws and bolts.
   4. Existing Concrete: Expansion bolts.
   5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
   6. Steel: Welded threaded studs or spring-tension clamps on steel.
      a. Field Welding: Comply with AWS D1.1.
   7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
   8. Light Steel: Sheet-metal screws.
   9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

M. Metal roof decking shall not be used to support electrical devices, boxes or raceway. Such installations shall be removed and reinstalled per Contract Documents at no cost to the Owner.

3.4 FIRESTOPPING

A. Any penetration of fire-rated assemblies shall include firestopping to cable and raceway penetrations to maintain the fire-resistance rating of the floor and wall assembly. Firestopping materials shall be listed for intended use and installed per applicable code and manufacturer requirements.

3.5 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement.

3.6 DEMOLITION

A. Protect existing electrical equipment and installations indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.

B. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.

C. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches (50 mm) below the surface of adjacent construction. Cap raceways and patch surface to match existing finish.

D. Remove demolished material from Project site.

E. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.

3.7 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces as required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

3.8 TRENCHING AND BACKFILL

A. Trenching work shall be performed in a manner consistent with the standard degree of care provided by professional contractors experienced in the trade.

B. Contractor is responsible to locate all existing underground utilities, locate and hand-dig as necessary to avoid damage to existing lines. Any damage that occurs while performing this Work shall be repaired by the Contractor at no additional cost.

C. Backfill: Provide ASTM D 2487, groups GW, GP, GM, SW, SP and/or SM soils, free of rock or debris. Place and compact fill material in 4-inch layers, uniformly moistened, and compacted by hand-operated tampers. Scarify and compact the top 6-inches of soil at 85-percent or higher.

3.9 REFINISHING AND TOUCHUP PAINTING

A. Refinish and touch up paint as required by this Work.
   1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
   2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
   3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.10 CLEANING AND PROTECTION

A. On completion of installation, inspect exposed finishes of all gear, fittings and devices. Remove paint splatters and other spots, dirt, and debris. Remove burrs, dirt, paint spots, and construction debris. Touch up scratches and mars of finish to match original finish

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS & CABLES

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 building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
   1. American Insulated Wire Corp.; a Leviton Company.
   2. General Cable Corporation.
   3. Houston Wire.
   4. Senator Wire & Cable Company.
   5. Southwire Company.

B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

C. Conductor Material: Copper, complying with NEMA WC 5 or 7; stranded or solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.

D. Conductors, Optional Material: The Contractor has the option to provide compact strand, Alcan Stabiloy XHHW-2 aluminum cable for feeders, #3 AWG or larger. All related terminations shall have CU/AL rated lugs. Cabling shall be installed per Alcan instructions using certified torque wrenches and all recommended materials. The Contractor is responsible for upsizing associated conductor and conduit sizes as required by Code.

E. Conductor Insulation Types: Types THHN-THWN, THHN/THWN-2, XHHW and XHHW-2 as defined herein, complying with NEMA WC 5 or 7.

F. Minimum wire size shall be No. 12 AWG, except No. 14 AWG shall be permitted for signal, pilot control circuits and fixture whips.

2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
   1. AFC Cable Systems, Inc.
   2. AMP Incorporated/Tyco International.
   3. Hubbell/Anderson.
   4. O-Z/Gedney; EGS Electrical Group LLC.
   5. 3M Company; Electrical Products Division.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

C. Connectors and fittings shall be rated for 75 degrees C.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

A. Feeder and Branch Circuits - Wet Locations: Type THHN/THWN-2 or XHHW-2, 90ºC in raceway.

B. Feeder and Branch Circuits - Dry and Damp Locations: Type THHN/THWN, THW, or XHHW in raceway.

C. Control Circuits: Type THHN-THWN, in raceway.

3.2 INSTALLATION

A. Refer to General Notes on Sheet E-1.0. Conceal all circuits and feeders unless otherwise noted.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Support cables according to Division 16 Section "Basic Electrical Materials and Methods."

E. Seal around cables penetrating fire-rated elements according fire-proofing manufacturer instructions.

F. Identify and color-code conductors and cables according to Division 16 Section "Electrical Identification".

G. Three-Phase Wiring: A maximum of three phase conductors, each of a different phase, and one common neutral shall be installed per conduit homerun. Derating factors for additional conductors installed in the same conduit shall be applied per NEC Table 310.

H. Use No. 10 AWG minimum conductor size in lieu of No. 12 AWG minimum for 20 ampere, 120 volt branch circuits where homeruns are longer than 75 feet and for 20 ampere. Increase in size as required for a maximum of 3 percent voltage drop from panel to load.

3.3 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
   1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.4 FIELD QUALITY CONTROL

A. Testing: Engage qualified staff to perform the following field quality-control testing:

B. Testing: Perform the following field quality-control testing:
   1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
   2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.

C. Test Reports: Submit a written report documenting:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION

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SECTION 26 05 33

RACEWAYS & BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Raceways and fittings.
   2. Boxes, enclosures, and cabinets for electrical wiring.
   3. Mounting Heights for boxes, devices and equipment.

B. Related Sections include the following:
   1. Division 16 Section "Basic Electrical Materials and Methods" for supports, anchors, and other support products, including installation restrictions.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. FMC: Flexible metal conduit.

C. IMC: Intermediate metal conduit.

D. LFMC: Liquidtight flexible metal conduit.

E. RNC: Rigid nonmetallic conduit.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including duct work, HVAC equipment and other assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 METAL CONDUIT AND TUBING

A. Available Manufacturers:
   1. AFC Cable Systems, Inc.
   2. Alflex Inc.
   3. Anamet Electrical, Inc.; Anaconda Metal Hose.
   4. Electri-Flex Co.
   5. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
   6. LTV Steel Tubular Products Company.
   7. Manhattan/CDT/Cole-Flex.
   8. O-Z Gedney; Unit of General Signal.
   9. Wheatland Tube Co.

B. Rigid Steel Conduit: Steel, hot-dipped galvanized, UL-6, ANSI C80.1.

C. IMC: ANSI C80.6.

D. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.

E. Plastic-Coated IMC and Fittings: NEMA RN 1. Conduit shall have 40 mil PVC exterior coating with a red urethane interior coating.

F. EMT and Fittings: Steel, hot-zinc galvanized, UL-797, ANSI C80.3 for use in open and concealed installations.
   1. Fittings: Steel compression type.

G. FMC: Zinc-coated steel.

H. LFMC: Flexible steel conduit with PVC jacket.

I. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

2.3 NONMETALLIC CONDUIT AND TUBING

A. Available Manufacturers:
   1. American International.
   2. Anamet Electrical, Inc.; Anaconda Metal Hose.
   3. Arnco Corp.
   4. Cantex Inc.
   5. Certainteed Corp.; Pipe & Plastics Group.
   6. Condux International.
   7. ElecSYS, Inc.
   8. Electri-Flex Co.
   9. Lamson & Sessions; Carlon Electrical Products.
   10. Manhattan/CDT/Cole-Flex.
   11. RACO; Division of Hubbell, Inc.

12. Spiralduct, Inc./AFC Cable Systems, Inc.
13. Thomas & Betts Corporation.

B. ENT: NEMA TC 13.

C. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC. UL 651, NEMA TC-2, rated for 90 deg C and sunlight resistant.

D. ENT and RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.

E. LFNC: UL 1660.

2.4 CONDUIT BODIES

A. General: Types, shapes, and sizes as required to suit individual applications and NEC requirements. Provide matching gasketed covers secured with corrosion-resistant screws.

B. Metallic Conduit and Tubing: Use metallic conduit bodies. Use bodies with threaded hubs for threaded raceways.

C. Conduit Bodies 2 Inches and Smaller: Use steel bodies with compression-type EMT connectors. Die-cast or pressure cast fittings are not permitted.

D. Conduit Bodies 2-1/2 Inches - 4 Inches: Malleable.

E. Nonmetallic Conduit and Tubing: Use nonmetallic conduit bodies conforming to UL 514 B.

2.5 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating and field painted to match wall finished.
   1. Manufacturers:
      a. Airey-Thompson Sentinel Lighting; Wiremold Company (The).
      b. Thomas & Betts Corporation.
      c. Walker Systems, Inc.; Wiremold Company (The).
      d. Wiremold Company (The); Electrical Sales Division.

B. Types, sizes, lengths and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Available Manufacturers:
   1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
   2. Emerson/General Signal; Appleton Electric Company.
   3. Erickson Electrical Equipment Co.
   4. Hoffman.
   5. Hubbell, Inc.; Killark Electric Manufacturing Co.
   6. O-Z/Gedney; Unit of General Signal.
   7. RACO; Division of Hubbell, Inc.
   8. Robroy Industries, Inc.; Enclosure Division.
   9. Scott Fetzer Co.; Adalet-PLM Division.
   10. Spring City Electrical Manufacturing Co.
   11. Thomas & Betts Corporation.

12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.

D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

E. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

F. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
   2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.

2.7 FACTORY FINISHES

A. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard prime-coat finish ready for field painting.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors:
   1. Exposed: Rigid steel or IMC.
   2. Concealed: Rigid steel or IMC.
   3. Underground, Single Run: RNC.
   4. Underground, Grouped: RNC.
   5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
   6. Enclosures: NEMA 250, Type 3R.
   7. Boxes: Cast aluminum. Malleable iron prohibited.

B. Indoors:
   1. Exposed: EMT.
   2. Concealed: EMT.
   3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.
   4. Damp or Wet Locations: Rigid steel conduit.
   5. Boxes and Enclosures: NEMA 250, Type 1, Type 4 stainless steel in damp or wet locations.

C. Minimum Raceway Size: 1/2-inch trade size, 3/4-inch trade size minimum for 120V multi-circuit homeruns.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.
   1. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
   2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.

3.2 INSTALLATION

A. Refer to General Notes on Sheet E-1.0.

B. Stub conduit up within equipment curbs for serving roof-top mechanical equipment. Do not penetrate the existing roof.

C. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

D. Complete raceway installation before starting conductor installation.

E. Support raceways as specified in Division 16 Section "Basic Electrical Materials and Methods."

F. Install temporary closures to prevent foreign matter from entering raceways.

G. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

H. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

I. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
   1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

J. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
   1. Run parallel or banked raceways together on common supports.
   2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

K. Join raceways with fittings designed and approved for that purpose and make joints tight.
   1. Use insulating bushings to protect conductors.

L. Terminations:
   1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
   2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

M. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

N. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

2. Where otherwise required by NFPA 70.

O. Stub-up Connections: For stub-ups to freestanding equipment, provide coated RGS ells and RGS stub-ups to connections at each equipment housing.

P. Flexible Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for all motors. Use of flexible conduit in finished spaces with exposed structure is unacceptable. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

Q. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals. Use is limited circuits that need to be surface mounted on masonry walls in finished spaces. Standard conduit surface mounted in corridors and painted to match is acceptable where approved by the Owner.

R. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

S. Expansion Joints:
1. Conduits 3 inches and larger, rigidly secured to building construction on opposite sides of a building expansion joint, shall be provided with expansion and deflection couplings. The couplings shall be installed in accordance with the manufacturer's recommendations.
2. Conduits smaller than 3 inches shall be provided with junction boxes on both sides of the expansion joint, and connected by 15 inches of slack flexible conduit. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above may be installed.
3. Expansion and deflection couplings shall also be installed where shown on the drawings.

T. Mounting Heights: Install equipment and devices at heights indicated in Table 1 (located at the end of this Section), unless noted otherwise.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.4 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

3.5 GRADING AND PLANTING

A. Restore existing surface features, including vegetation, at areas disturbed by Work of this Section and Section 26 0526 Grounding. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Restore disturbed paving to match original.

TABLE 1

MOUNTING HEIGHT SCHEDULE

Device	Centerline of Box Above Finished Floor
1. Fire Alarm LED Annunciator	54 inches
2. Disconnect Switch	54 inches
3. Panelboard	72 inches to top

For devices mounted in rooms with similar existing devices, revise mounting heights to match; and as required by local code.

END OF SECTION

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SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

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 electrical identification materials and devices required to comply with ANSI C2, NFPA 70, OSHA standards, and authorities having jurisdiction.

B. Applications include, but are not limited to the following:
   1. Indicate circuit numbers at junction boxes.
   2. Warning tape for underground conduit.
   3. Label all main disconnects per NEC.
   4. Label fire alarm conduit (except where exposed plenum cabling is installed).

C. Related Sections Include:
   1. Division 16 Section “Raceways and Boxes” for identification on divided raceway covers.

1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1 & C2, and NFPA 70,

PART 2 - PRODUCTS

2.1 RACEWAY AND CABLE LABELS

A. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide (0.08 mm thick by 25 to 51 mm wide).

2.2 NAMEPLATES AND SIGNS

A. Equipment Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.
   1. Engraved legend with white letters on a black face.
   2. Punched or drilled for mechanical fasteners.

B. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.

C. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.
   1. Minimum Width: 3/16 inch (5 mm).
   2. Tensile Strength: 50 lb (22.3 kg) minimum.
   3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
   4. Color: According to color-coding.

B. Paint: Formulated for the type of surface and intended use.
   1. Primer for Galvanized Metal: Single-component acrylic vehicle formulated for galvanized surfaces.
   2. Primer for Concrete Masonry Units: Heavy-duty-resin block filler.
   3. Primer for Concrete: Clear, alkali-resistant, binder-type sealer.
   4. Enamel: Silicone-alkyd or alkyd urethane as recommended by primer manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.

C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before applying.

E. Install painted identification according to manufacturer's written instructions and as follows:
   1. Clean surfaces of dust, loose material, and oily films before painting.
   2. Prime surfaces using type of primer specified for surface.
   3. Apply one intermediate and one finish coat of enamel.

F. Color Banding Raceways: Band exposed and accessible raceways of the systems listed below:
   1. Bands: Painted bands; colored adhesive tape; or a combination of both. Make each color band 2 inches (51 mm) wide, completely encircling conduit.
   2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
   3. Apply the following colors to the systems listed below:
      a. Fire Alarm System: Red.

G. Circuit Identification Labels on Boxes: Label the coverplate of j-boxes in unfinished spaces and above accessible ceilings using permanent black marker. Install labels externally.
   1. Labeling Legend: Permanent, waterproof, neatly written listing of panel and circuit number or equivalent.

H. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches (150 to 200 mm) below finished grade.

I. Color-Coding of Secondary Phase Conductors: Use the following colors for service, feeder and branch-circuit phase conductors:
   1. 208/120-V Conductors:
      a. Phase A: Black.
      b. Phase B: Red.
      c. Phase C: Blue.
      d. Neutral: White.
      e. Ground: Green.
   2. 240/120V Conductors: Match the color scheme above, except where using the existing color scheme in the building would prevent confusion in the field due to markings on associated existing circuits.
   3. Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:
      a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1-inch- (25-mm-) wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.
      b. Colored cable ties applied in groups of three ties of specified color to each wire at each terminal or splice point starting 3 inches (76 mm) from the terminal and spaced 3 inches (76 mm) apart. Apply with a special tool or pliers, tighten to a snug fit, and cut off excess length.

J. Apply warning, caution, and instruction signs as follows:
   1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
      a. Install a plaque on all disconnect switches controlling remote equipment that identifies its purpose per NEC.
      b. Install a plaque at each main disconnect for services with multiple main disconnects per NEC.

K. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high lettering on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high. Use white lettering on black field. Apply labels for each unit of the following categories of equipment using mechanical fasteners:
   1. Electrical gear, Panelboards, electrical cabinets, and enclosures.
   2. Access doors and panels for concealed electrical items.
   3. Disconnect switches.
   4. Motor starters.

END OF SECTION

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SECTION 26 24 10

PANELBOARDS

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 lighting and power panelboards and associated auxiliary equipment rated 600 V and less.

B. Related Sections include the following:
   1. Division 16 Section "Basic Electrical Materials and Methods" for general materials and installation methods.
   2. Division 16 Section "Electrical Identification" for labeling materials.
   3. Division 16 Section "Field Quality Control."

1.3 SUBMITTALS

A. Product Data: For each type of panelboard, accessory item, and component specified.

B. Shop Drawings: For distribution panelboards. Include dimensioned plans and elevations. Show tabulations of installed devices, major features, and voltage rating. Include the following:
   1. Enclosure type with details for types other than NEMA 250, Type 1.
   2. Bus configuration and current ratings.
   3. Short-circuit current rating of panelboard.
   4. Features, characteristics, ratings, and factory settings of OCPD and auxiliary components.

C. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

D. Maintenance Data: For panelboard components to include in the maintenance manuals specified in Division 1. Include manufacturer's written instructions for testing circuit breakers.

1.4 QUALITY ASSURANCE

A. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
   1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
   2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

B. Comply with NFPA 70 and NEMA PB 1

1.5 EXTRA MATERIALS

A. Keys: 6 spares of each type for panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Eaton Corp.; Cutler-Hammer Products.
   2. General Electric Co.; Electrical Distribution & Control Div.
   3. Siemens Energy & Automation, Inc.
   4. Square D Co.

2.2 PANELBOARD FABRICATION

A. Enclosures: Flush- or surface-mounted cabinets as indicated. NEMA PB 1, Type 1, unless otherwise indicated to meet environmental conditions at installed location.

B. Front: Secured to box with concealed trim clamps, unless otherwise indicated. Front for surface-mounted panelboards shall be same dimensions as box. Fronts for flush panelboards shall overlap box, unless otherwise indicated.

C. Directory Frame: Metal, mounted inside each panelboard door.

D. Bus: Tin-plated copper of 98 percent conductivity.

E. Main and Neutral Lugs: Mechanical lug type, rated UL/CSA CU/AL, 75 degrees C.

F. Equipment Ground Bus: Copper, adequate for feeder and branch-circuit equipment ground conductors. Bonded to box.

G. Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for the overcurrent protective device ampere ratings indicated for future installation of devices. All spaces in gear shall be ‘prepared spaces’. Include the following:
   1. Configure for installing a future internal surge protection device. SPD rated 100kA.

H. Minimum Interrupting Capacity: 10,000 AIC for 240 volt panels.
   1. Panelboards shall have AIC ratings greater than or equal to the available fault currently listed on the drawings.
   2. Series rating of OCPD's shall not be acceptable.

I. Feed-through Lugs: Sized to accommodate feeders indicated.

J. Hinged Front Cover: For each interior panel, the entire front trim shall be hinged to box with standard door within hinged trim cover

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

B. Doors: In panelboard front, with concealed hinges. Secure with flush catch and tumbler lock, all keyed alike.

2.4 DISTRIBUTION PANELBOARDS

A. General: UL, Type 3R, main breaker, 96-inch branch breaker mounting height, with ratings and features as specified and noted on the Drawings.

B. Service Equipment: Listed for use as service equipment with main service disconnect.

C. Doors: Wet location, gasketed, with secure door with vault-type latch with tumbler lock, all keyed alike.

D. Branch-Circuit Breakers: Where overcurrent protective devices are indicated to be circuit breakers, use bolt-on circuit breakers, except circuit breakers 225-A frame size and greater may be plug-in type where individual positive-locking device requires mechanical release for removal.

E. Style: Provide Square D I-Line power panelboards (up to 1200A MLO or MCB) or approved equal.

2.5 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: NEMA AB 1, handle lockable.
   1. Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated and interrupting capacity rating to meet available fault current.
   2. Application Listing: Appropriate for application and load(s) served.
   3. Circuit Breakers, 200 A and Larger: Trip units interchangeable within frame size.
   4. Circuit Breakers, 400 A and Larger: Field-adjustable short-time and continuous current settings.
   5. Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards and accessory items according to NEMA PB 1.1.

B. Mounting Heights: Refer to Mounting Height Schedule, Division 16 Section 16130 “Raceway and Boxes.”

C. Mounting: Plumb and rigid without distortion of box. Mount flush panelboards uniformly flush with wall finish.

D. Circuit Directory: Type directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing.

E. Install filler plates in unused spaces.

F. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

G. Wiring in Panelboard Gutters: Arrange conductors into groups, and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

A. Identify field-installed wiring and components and provide warning signs as specified in Division 16 Section "Electrical Identification."

B. Panelboard Nameplates: Label each panelboard with engraved laminated-plastic or metal nameplates mounted with corrosion-resistant screws.

C. Distribution Panelboards: Label each circuit breaker with an engraved laminated plastic nameplate.

3.3 GROUNDING

A. Make equipment grounding connections for panelboards as indicated.

B. Provide ground continuity to main electrical ground bus as indicated.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

END OF SECTION

SECTION 26 27 00

FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Fuses.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each fuse type specified.

C. Maintenance data for tripping devices to include in the operation and maintenance manual specified in Division 1.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses from one source and by a single manufacturer.

B. Comply with NFPA 70 for components and installation.

C. Listing and Labeling: Provide fuses specified in this Section that are listed and labeled.
   1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

1.5 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
   1. Spare Fuses: Furnish quantity equal to 20 percent of each fuse type and size installed, but not less than 1 set of 3 of each type and size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide fuses by one of the following:
   1. Cooper Industries, Inc.; Bussmann Div.
   2. Gould Shawmut.
   3. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class as specified or indicated; current rating as indicated; voltage rating consistent with circuit voltage.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions to verify proper fuse locations, sizes, and characteristics.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Feeders, 0 - 600 Amperes: Class RK1, dual element, time delay.

B. Motor Branch Circuits: Class RK1, dual element, time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices as indicated. Arrange fuses so fuse ratings are readable without removing fuse.

B. Fuses in distribution equipment shall be factory installed.

C. Install fuses in fusible devices as indicated. Field coordinate fusing and disconnects provided under Mechancial scope of work.

3.4 IDENTIFICATION

A. Install typewritten labels on inside door of each fused switch to indicate fuse replacement information.

END OF SECTION

SECTION 26 28 16

DISCONNECT SWITCHES

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 individually mounted disconnect switches and used for the following:
   1. Service disconnecting means.
   2. Feeder and branch-circuit protection.
   3. Motor and equipment disconnecting means.

B. Related Sections include the following:
   1. Section "Fuses" for fusible devices.
   2. Section “Field Quality Control.

1.3 SUBMITTALS

A. Product Data: For each type of switch, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Maintenance Data: For disconnect switches and for components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Closeout Procedures," include the following:
   1. Routine maintenance requirements for components.
   2. Manufacturer's written instructions for testing and adjusting switches.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NEMA AB 1, NEMA KS 1 and NFPA 70.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
   1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
   2. Altitude: Not exceeding 6600 feet (2000 m).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Fusible Switches:
      a. Cutler Hammer/Westinghouse.
      b. General Electric Co.; Electrical Distribution & Control Division.
      c. Siemens Energy & Automation, Inc.
      d. Square D Co.

2.2 DISCONNECT SWITCHES

A. Enclosed, Nonfusible Switch: NEMA KS 1, Type HD, with lockable handle.

B. Enclosed, Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, with clips to accommodate specified fuses, lockable handle with two padlocks, and interlocked with cover in closed position.

2.3 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
   1. Outdoor Locations: NEMA 250, Type 3R.

2.4 FACTORY FINISHES

A. Manufacturer's standard prime-coat finish ready for field painting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive disconnect switches for compliance with installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with mounting and anchoring requirements specified in Division 16 Section "Seismic Controls for Electrical Work."

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section "Basic Electrical Materials and Methods".

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.4 CONNECTIONS

A. Install equipment grounding connections for switches with ground continuity to main electrical ground bus.

B. Install power wiring. Install wiring between switches and control and indication devices.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 CLEANING

A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION

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SECTION 26 29 00

MOTOR CONTROLLERS

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 ac motor-control devices rated 600 V and less that are supplied as enclosed units.

B. Related Sections include the following:
1. Section "Basic Electrical Materials and Methods" for general materials and installation methods.
2. Section "Fuses."
3. Section "Field Quality Control."

1.3 SUBMITTALS

A. Product Data: For products specified in this Section. Include dimensions, ratings, and data on features and components.

B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

C. Maintenance Data: For products to include in the maintenance manuals specified in Division 1.

D. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain, within 100 miles (160 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Source Limitations: Obtain similar motor-control devices through one source from a single manufacturer.

C. Comply with NFPA 70.

D. Listing and Labeling: Provide motor controllers specified in this Section that are listed and labeled.
1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

1.5 COORDINATION

A. Coordinate motor starters being furnished and installed under the Mechanical scope of work.

B. Coordinate features of controllers and accessory devices with pilot devices and control circuits to which they connect.

C. Coordinate features, accessories, and functions of each motor controller with the ratings and characteristics of the supply circuit, the motor, the required control sequence, and the duty cycle of the motor and load.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Corp.; Westinghouse & Cutler-Hammer Products.
   2. General Electric Co.; Electrical Distribution & Control Div.
   3. Siemens Energy & Automation, Inc.
   4. Square D Co.

2.2 MANUAL MOTOR CONTROLLERS

A. Manual Switch, Motor-Rated: Manual on-off controller, 1, 2 or 3 pole, with toggle operator. 600V, rated up to 3HP, 1-phase or 10HP, 3 phase maximum.

2.3 ENCLOSURES

A. Description: Flush or surface-mounted cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to meet environmental conditions at installed location.
   1. Outdoor Locations: NEMA 250, Type 3R.
   2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
   3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
   4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Refer to Mechanical Equipment schedules and related notes.

B. Use magnetic controller for automatically controlled three-phase motors except where other types of controllers are indicated.

C. Select features of each motor controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, drive, and load; and configuration of pilot device and control circuit affecting controller functions.

D. Select horsepower rating of controllers to suit motor controlled.

E. Provide manual switch, motor rated, for local disconnect on exhaust fans and other fractional-horsepower, single-phase motors, unless otherwise indicated.

3.2 INSTALLATION

A. Install independently mounted motor-control devices according to manufacturer's written instructions.

B. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components, including the pretesting and adjustment of solid-state controllers.

C. Location: Locate manual controllers adjacent to each motor controlled, unless otherwise indicated.

3.3 IDENTIFICATION

A. Identify motor-control components and control wiring according to Division 16 Section "Basic Electrical Materials and Methods."

3.4 CONTROL WIRING INSTALLATION

A. Bundle, train, and support wiring in enclosures.

3.5 CONNECTIONS

A. Tighten connectors, terminals, bus joints, and mountings. Tighten field-connected connectors and terminals, including screws and bolts, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

END OF SECTION

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SECTION 26 90 00

FIELD QUALITY CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This section includes field quality and testing requirements for equipment and their installation previously specified in other Division 16 sections.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1.

B. Ground resistance test report.

C. Final versions of Panel Schedules.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check for proper tightness of all electrical connections and in accordance with manufacturers recommended values.

B. Perform electrical tests and inspections as stated in ANSI/NETA ATS and manufacturer instructions. Certify compliance with test parameters.
   1. Distribution Gear and Panelboards: NETA ATS Chapter 7.1.
   2. Low Voltage Cables: NETA ATS Chapter 7.3.1
   3. Breakers 150A & larger: NETA ATS Chapter 7.6.1.1.

3.2 ADDITIONAL REQUIREMENTS

A. Conductors and Cables:
   1. Prior to energization, check for continuity and for short circuits.
   2. Perform insulation resistance test with megohm meter for all feeders. Apply 1000V to 600V conductors for a period of 60 seconds.
   3. Replace failing conductors.

B. Wiring Devices:
   1. Test ground fault interrupters for proper operation.
   2. Ensure proper polarity of connections.

3. Replace malfunctioning units.

C. Grounding:
   1. Measure the resistance of the main grounding electrode under normal dry conditions using Fall of-Potential Method in accordance with IEEE or a certified hand-held clamp-on ground resistance tester as manufactured by AEMC. Resistance shall not exceed 20 ohms.

D. Panelboards:
   1. Measure steady state load currents at each panelboard. Should differences between phases exceed 10 percent, rearrange circuits to balance the phase loads within 10 percent. Take care to maintain proper phasing for multi-wire branch circuits.
   2. Submit final versions of Panel Schedules after load balancing.
   3. Check tightness of all bolted connections of feeders and factory bus connections with calibrated torque wrench.

E. Overcurrent Protective Devices:
   1. Verify indicated rating and settings to be appropriate for final system arrangement and parameters. Where discrepancies are found, recommend final device ratings and settings. Use accepted revised ratings or settings to make the final system adjustments.
   2. Verify installation of proper fuse types and ratings in fusible OCPDs.
   3. Check for proper operation, including interlocks, relays, shunt-trips, and other safety devices.

F. Motor Controllers:
   1. Verify installation of proper controllers and disconnect functions.
   2. Verify fuse types and ratings in fusible devices match equipment and motor requirements.
   3. Verify installation of proper overload relay heaters in starters.

G. Interior Lighting: The following applies only to fixtures reinstalled under this Work.
   1. Interrupt power to demonstrate proper operation of emergency lighting installation. Replace or repair fixtures and components damaged during this Work.
   2. Inspect each fixture. Replace damaged fixtures and components.

H. Fire Alarm System: This applies to the devices and wiring installed under this Work.
   1. Verify the absence of unwanted voltages between circuit conductors and ground.
   2. Megger test all conductors other than those intentionally and permanently grounded with electronic components disconnected. Test for resistance to ground. Report readings less than 1-megohm for evaluation.
   3. Test all conductors for short circuits utilizing an insulation-testing device.
   4. With each circuit pair, short circuit at the far end of the circuit and measure the circuit resistance with an ohmmeter. Record the circuit resistance of each circuit on the record drawings.
   5. Verify the control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.
   6. Test initiating and indicating circuits for proper signal transmission under open circuit conditions. One connection each should be opened at not less than 10 percent of the initiating and indicating devices. Observe proper signal transmission according to class of wiring used.
   7. Test each initiating and indicating device for alarm operation and proper response at the control unit. Test smoke detectors with actual products of combustion.
   8. Verify all system functions are operating correctly. Systematically initiate specified functional performance items at each station including making all possible alarm and monitoring initiations and using all communications options. For each item, observe related performance at all devices required to be affected by the item under all system sequences. Observe indicating lights, displays, signal tones, and annunciator indications.

Observe all voice audio for routing, clarity, quality, freedom from noise and distortion, and proper volume level.

9. Test both primary power and secondary power. Verify, by test, the secondary power system is capable of operating the system for the period and in the manner specified.

END OF SECTION

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SECTION 28 31 00

FIRE ALARM SYSTEMS

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 adding devices to an existing Silent Knight fire alarm system and updating programming at the existing control panel (FACP) and remote annunciator panel (FAA).

1.3 SYSTEM DESCRIPTION

A. General: Existing, zoned, non-coded addressable fire-detection and alarm system with manual and automatic alarm initiation.

B. Signal Transmission: Multiplex signal transmission dedicated to fire alarm service only.

C. Audible Alarm Indication: By sounding existing audible devices.

D. Visual Alarm Indication: By existing strobe-type units.

E. System connections for alarm-initiating and alarm-indicating circuits shall match existing wiring.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each type of system component specified including dimensioned plans and elevations showing minimum clearances and installed features and devices. Include list of materials and Nationally Recognized Testing Laboratory (NRTL)-listing data.

C. Orientation Plan: Provide updates to the fire alarm system floor plan located at the main entry. Replace the plans as required.

D. Device Address List: Coordinate with final system programming.

E. System operation description covering this specific Project, including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are unacceptable.

F. Product certificates signed by manufacturers of fire alarm system components certifying that their products comply with specified requirements.

G. Maintenance data for fire alarm systems to include in the operation and maintenance manual specified in Division 1. Include data for each type of product, including all features and operating sequences, both automatic and manual. Include recommendations for spare parts to be stocked at the site. Provide the names, addresses, and telephone numbers of service organizations that carry stock of repair parts for the system to be furnished.

H. Submission to Authorities Having Jurisdiction: In addition to routine submission of the above material, make an identical submission to the authorities having jurisdiction. Include copies of annotated Contract Drawings as needed to depict component locations to facilitate review. Upon receipt of comments from the authorities having jurisdiction, submit them for review. Resubmit if required to make clarifications or revisions to obtain approval.

I. Record of field tests of system.

J. Fire alarm system certification and description. See Section "Field Quality Control."

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced factory-authorized Installer to perform work of this Section.

B. Single-Source Responsibility: Obtain fire alarm components from a single source who assumes responsibility for compatibility of system components.

C. Compliance with Local Requirements: Comply with the applicable building code, local ordinances, and regulations, and the requirements of the authorities having jurisdiction.

D. Comply with NEC/NFPA 70.

E. Comply with IFC and all applicable local codes.

F. Listing and Labeling: Provide fire alarm systems and components specified in this Section that are listed and labeled by Factory Mutual.

G. Listing and Labeling: Provide systems and equipment specified in this Section that are listed and labeled.
   1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
   2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

1.6 SEQUENCING AND SCHEDULING

A. Maintain the fire alarm system and all existing devices during the installation of this Work. The Contractor shall meet all Fire Marshal requirements for any outages of the existing system and phasing of the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products UL Listed for use with the existing Silent Knight FA System.

2.2 CONTROL PANEL

A. The existing fire alarm control panel is an addressable, Silent Knight Model IFP-1000.

2.3 REMOTE ANNUNCIATOR PANEL

A. The existing remote annunciator is a Silent Knight Model RA-100.

2.4 EMERGENCY POWER

A. As part of this Work, the existing fire alarm emergency battery shall be reviewed and upsized as required based on the load of all added devices and as required to meet current Code.

2.5 FUNCTIONAL DESCRIPTION OF SYSTEM

A. The Contractor shall maintain all existing system functions and operating features:
   1. Priority of Signals.
   2. Fire Alarm Control Panel (FACP) Response: The manual or automatic operation of an alarm-initiating or supervisory-operating device causes the FACP to transmit an appropriate signal to match all existing functions. Those functions shall include, but are not limited to, the following:
      a. General alarm.
      b. Fire-suppression system operation alarm.
      c. Smoke or heat detector alarm.
      d. Valve tamper supervisory.
      e. System trouble.
      f. Fan shutdown.
   3. Maintain any testing functions of the existing system, allowing for the user to disable selected relays along with giving a trouble signal until switched back to normal position.
   4. Transmission to Remote Central Station: Automatically route alarm, supervisory, and trouble signals to a remote central station service.
   5. Silencing at the FACP.
   6. Loss of primary power.
   7. Annunciation at both on the FACP and on the annunciator, indicating location and type of device.
   8. FACP Alphanumeric Display: Displays plain-English-language descriptions and addresses of initiating devices, alarms, trouble signals, supervisory signals, monitoring actions, system and component status, and system commands.
   9. General Alarm functions.
   10. Manual station alarm operation initiates a general alarm.
   11. Water-flow alarm switch operation:
   12. Smoke detection of any duct detectors installed under this Work shall initiate a general alarm.
   13. Smoke detection for zones without alarm verification initiates a general alarm.

2.6 ADDRESSABLE DEVICES

A. Alarm-Initiating Devices: Classified as addressable devices according to NFPA 72.
   1. Communication Transmitter and Receiver: Integral to device. Provides each device with a unique identification and capability for status reporting to the FACP.
   2. External Addressable Interface Unit: May be used where specified devices are not manufactured and labeled with integral multiplex transmitter and receiver. Arrange to monitor status of each device individually.

2.7 SMOKE DUCT DETECTORS

A. General: Comply with UL 268. Include the following features:
   1. Factory Nameplate: Serial number and type identification.
   2. Operating Voltage: 24-V dc, nominal.
   3. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
   4. Plug-in Arrangement: Detector and associated encapsulated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection. The plug connection requires no springs for secure mounting and contact maintenance. Terminals in the fixed base accept building wiring.
   5. Integral Visual Indicating Light: Connect to indicate detector has operated.

B. Duct Smoke Detector: Photoelectric type
   1. Sampling Tube: Photoelectric duct detector with matching housing. Silent Knight Model SD-505-APS and SD-505-ADHR housing or approved equal.
   2. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.
   3. Include sampling tubes as required for each duct installation.
   4. Include remote test station; with red LED status indicator lamp and keyed switch with “Test” & “Normal” positions. Silent Knight Model SD-505-DTS-K or approved equal.

2.8 WIRE

A. Wire: Provide conductors UL listed for intended application; as recommended by manufacturer and to match existing.

2.9 ORIENTATION PLAN

A. Orientation Plan: Provide an updated scaled floor plan for the building showing the existing fire alarm device locations and information, and the added devices with information to match existing. The graphic information, color, size, framing, mounting shall match existing and include the designation showing "You are Here".

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install system according to NFPA standards referenced in Parts 1 and 2 of this Section.

3.2 EQUIPMENT INSTALLATION

A. Remote Test Switches: Mount on wall or in ceiling below the duct detector each device monitors. Provide a label with ID information that matches the associated roof top unit.

B. Duct Detectors shall be furnished and installed under this Section.

C. Installer shall limit the quantity of devices on Notification Appliance Circuits and the total connected ampacity on the power circuit to maintain a minimum of 20% spare capacity.

3.3 WIRING INSTALLATION

A. Wiring Method: Install wiring in metal raceway according to Section "Raceways & Boxes”. Conceal raceway except in unfinished spaces and as indicated.

B. Wiring within Enclosures: Install conductors parallel with or at right angles to the sides and back of the enclosure. Bundle, lace, and train the conductors to terminal points. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

C. Cable Taps: Use numbered terminal strips in junction, pull or outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

D. Color Coding: Color-code fire alarm conductors to match existing; including marking of raceway system.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals according to Division 16 Section "Basic Electrical Materials and Methods."

3.5 GROUNDING

A. Ground cable shields and equipment according to system manufacturer's instructions to eliminate shock hazard and to minimize, to the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments.

B. Install grounding electrodes of type, size, location, and quantity as indicated. Comply with installation requirements of Section "Grounding & Bonding."

C. Ground equipment and conductor and cable shields.

3.6 CLEANING AND ADJUSTING

A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Touch up scratches and marred finish to match original finish. Clean unit internally using methods and materials recommended by manufacturer.

3.7 DEMONSTRATION

A. Startup Services: Engage a factory-authorized service representative to provide startup service and to demonstrate and train Owner's maintenance personnel as specified below.
   1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, adjusting, and preventive maintenance. Provide a minimum of 2 hours' training.
   2. Training Aid: Use the approved final version of the operation and maintenance manual as a training aid.
   3. Schedule training with Owner with at least 7 days' advance notice.

3.8 ON-SITE ASSISTANCE

A. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels, controls, and sensitivities to suit actual occupied conditions. Provide up to 3 requested adjustment visits to the site for this purpose.

END OF SECTION