PROJECT MANUAL

for

TOWN OF GLASTONBURY
Air Conditioning Installation
at
Gideon Welles Elementary School

PROJECT # GL-2019-16

Bemis Associates LLC
185 Main Street
Farmington, Connecticut 06032

November 1, 2018

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TOWN OF GLASTONBURY

INVITATION TO BID

BID #	ITEM	DATE & TIME REQUIRED
GL-2019-16	Air Conditioning Installation at Gideon Welles Elementary School	January 10, 2019 @ 11:00 a.m.

The Town of Glastonbury is seeking bids for the installation of VRF Air Conditioning systems at Gideon Welles Elementary School, 1029 Neipsic Road, Glastonbury, CT 06033.

A mandatory pre-bid meeting and site walk through will be held at the Gideon Welles School, 1029 Neipsic Road, Glastonbury, CT 06033 on December 20, 2018 at 2:00 p.m.

Bid Forms may be downloaded from the Town's website at www.glastonbury-ct.gov or the State of Connecticut Department of Administrative Services website at www.das.state.ct.us at no cost.

Prevailing Wages: The contractor must comply with Section 31-53 of the Connecticut General Statutes as amended, including annual adjustments in prevailing wages.

Bid Security shall be issued payable to the "Town of Glastonbury" in the form of a certified check or Bid Bond in an amount not less than 10% of the total amount of the base bid. The Bid Bond must be issued by a surety company licensed in the State of Connecticut. Cashier's checks will not be accepted.

The Town reserves the right to waive informalities or reject any part of, or the entire bid, when said action is deemed to be in the best interest of the Town. All Sealed Bids must be submitted to the Office of the Purchasing Agent no later than the time and date indicated. All bids will be publicly opened and read.

The Town of Glastonbury is an Affirmative Action/Equal Opportunity Employer.
Minority/Women/Disadvantaged Business Enterprises are encouraged to bid.

Mary F. Visone
Purchasing Agent

1. Sealed bids **(one original and one copy)** on the attached Bid Forms will be received at the Office of the Purchasing Agent, Town Hall, 2155 Main Street, Glastonbury, Connecticut, 06033 (second level). At the designated time of opening, they will be publicly opened, read, recorded and placed on file.

2. Whenever it is deemed to be in the best interest of the Town, the Town Manager, Purchasing Agent or designated representative shall waive informalities in any and all bids. The right is reserved to reject any bid, or any part of any bid, when such action is deemed to be in the best interest of the Town of Glastonbury.

3. The basis of award will be based on the total of the lump sum base bid plus the sum of any alternate(s) accepted by the Owner of the lowest qualified, responsible and responsive bidder meeting the specifications herein.

4. Bids will be carefully evaluated as to conformance with stated specifications.

5. The envelope enclosing your bid should be clearly marked by your company name and address, bid number, time of bid opening, and date.

6. Specifications must be submitted complete in every detail and, when requested, samples shall be provided. If a bid involves any exception from stated specifications, they must be clearly noted as exceptions, underlined, and attached to the bid.

7. The Bid Documents contain the provisions required for the requested item. Information obtained from an officer, agent, or employee of the Town or any other person shall not affect the risks or obligations assumed by the Bidder or relieve him/her from fulfilling any of the conditions of the bid.

8. Each Bidder is held responsible for the examination and/or to have acquainted themselves with any conditions at the job site which would affect their work before submitting a bid. Failure to meet these criteria shall not relieve the Bidder of the responsibility of completing the bid without extra cost to the Town of Glastonbury.

9. Any bid may be withdrawn prior to the above-scheduled time for the opening of bids or authorized postponement thereof. Any bid received after the time and the date specified shall not be considered. No bidder may withdraw a bid within sixty (60) days after the actual date of the opening thereof. Should there be reasons why a bid cannot be awarded within the specified period, the time may be extended by mutual agreement between the Town and the Bidder.

10. Each bid must be accompanied by a bid bond payable to the Town for ten percent (10%) of the total amount of the bid. The bid bond of the successful bidder will be retained until the payment bond and performance bond have been executed and approved, after which it will be returned. A certified check may be used in lieu of a bid bond. The Town of Glastonbury will not be liable for the accrual of any interest on any certified check submitted. Cashier's checks will not be accepted.

11. A 100% Performance and Payment bond is required of the successful bidder. This bond shall cover all aspects of the specification and shall be delivered to the Purchasing Agent prior to the issuance of a purchase order. The Performance and Payment Bond will be returned upon the delivery and acceptance of the bid items.

12. The Bidder agrees and warrants that in the submission of this sealed Bid, they will not discriminate or permit discrimination against any person or group of persons on the grounds of race, color, religion, national origin, sex, or physical disability including, but not limited to blindness, unless it is shown by such Bidder that such disability prevents performance of that which must be done to successfully fulfill the terms of this sealed Bid or in any manner which is prohibited by the laws of the United States or the State of Connecticut: and further agrees to provide the Human Relations Commission with such information requested by the Commission concerning the employment practices and procedures of the Bidder. An Affirmative Action Statement will be required by the successful Bidder.

13. Bidder agrees to comply with all of the latest Federal and State Safety Standards and Regulations and certifies that all work required in this bid will conform to and comply with said standards and regulations. Bidder further agrees to indemnify and hold harmless the Town for all damages assessed against the Town as a result of Bidder's failure to comply with said standards and/or regulations.

14. All correspondence regarding any purchase made by the Town of Glastonbury shall reference the Town purchase order number. Each shipping container shall clearly indicate both purchase order number and item number.

15. Bidder is required to review the Town of Glastonbury Code of Ethics adopted July 8th, 2003 and effective August 1, 2003 and revised October 29, 2013 and effective November 8, 2013. Bidder shall acknowledge that they have reviewed the document in the area provided on the bid / proposal response page (BP). The selected Bidder will also be required to complete and sign an Acknowledgement Form prior to award. The Code of Ethics and the Consultant Acknowledgement Form can be accessed at the Town of Glastonbury website at **www.glastonbury-ct.gov.** Upon entering the website click on **Bids & Proposals Icon**, which will bring you to the links for the **Code of Ethics** and the **Consultant Acknowledgement Form**. If the Bidder does not have access to the internet a copy of these documents can be obtained through the Purchasing Department at the address listed within this bid / proposal.

16. Any bidder, in order to be considered, shall be engaged primarily in the business of construction/HVAC with for minimum of five (5) years and have a valid HVAC contractor's license in the State of Connecticut. Bidder shall submit a copy with the bid response.

17. **Non-Resident Contractors (IF APPLICABLE):Resident Contractors:**

    Upon award the Town is required to report names of nonresident (out of state) Contractors to the State of Connecticut, Department of Revenue Services (DRS) to ensure that Employment Taxes and other applicable taxes are being paid by Contractors. **A single surety bond for 5% of the entire contract price is required to be filed with DRS by any unverified nonresident prime or general contractor (if awarded) where the contract price for the project is $250,000 or more.** The contractor will be required to promptly furnish to the Town a copy of the **Form AU-968 - Certificate of Compliance** issued by the State of Connecticut, DRS. See State of Connecticut **Notice SN 2012 (2)**.

18. Bidder shall include on a sheet(s) attached to its proposal a complete disclosure of all past and pending mediation, arbitration and litigation cases that the bidder or its principals (regardless of their place of employment) have been involved in for the most recent five years. Please include a

statement of the issues in dispute and their resolution. Acceptability of Bidder based upon this disclosure shall lie solely with the Town.

19. Bidder or its principals, regardless of their place of employment, shall not have been convicted of, nor entered any plea of guilty, or nolo contendere, or otherwise have been found civilly liable or criminally responsible for any criminal offense or civil action. Bidder shall not be in violation of any State or local ethics standards or other offenses arising out of the submission of bids or proposals, or performance of work on public works projects or contracts.

20. After award of Contract, Owner will require the Contractor's Schedule of Values, which shall be submitted at the preconstruction meeting. The Schedule of Values must accurately reflect job costs and include a complete breakdown of material and labor costs.

21. Prevailing Wage Rates:

    Bidders shall comply with State Statutes concerning Employment and Labor Practices, if applicable, and Section 31-53 of the Connecticut General Statutes, as amended (Prevailing Wages). Wage Rate Determination for this project from the State of Connecticut is included in the Bid Documents. Certified payrolls for site labor shall be submitted weekly to the Town's Representative or his designee on the correct State of Connecticut form. The Town reserves the right to, without prior notice, audit payroll checks given to workers on site in order to ascertain that wages and fringe benefits are being paid as required by the State of Connecticut. Please make special note of the State requirement to adjust wage and fringe benefit rates on each July 1st following the original published rates.

    NOTE that bidder is to include in its bid proposal all costs required by such annual increases in the PREVAILING RATES. No Escalation Clauses are to be included in the bidder's proposal and no Escalation Clauses will be in the Contract Agreement. Bidder is to anticipate any future increases and include these costs in its quotation.

    Contractor's invoices will not be paid if certified payrolls are incomplete, incorrect or not received in a timely manner.

    All Apprentices must be registered with the State of Connecticut and their number shall not exceed the number allowed by law. Otherwise, all workers must be paid at least the Journeyman rate listed including benefits.

    OSHA SAFETY AND HEALTH CERTIFICATION: Effective July 1, 2009: Any Mechanic, Laborer, or Worker, who performs work in a classification listed on the prevailing wage rate schedule on any public works project covered under C.G.S. Section 31-53, both on site and on or in the public building, must have completed a federal OSHA Safety and Health course within the last 5 years.

22. Each Bidder shall submit a list of similar projects completed within the last three years. In order to be eligible for consideration, the Bidder must have successfully completed a minimum of five (5) similar projects within the last three (3) years. Please provide project name and contact information for project coordinator (name, title, address, phone number). Please also provide contract value.

23. **Compliance with Town Ordinance Prohibiting Natural Gas Waste & Oil Waste From Natural Gas Extraction Activities or Oil Extraction Activities:** If this bid is for the construction, repair or maintenance of Town owned and/or maintained roads or real property within the Town related to either (a) the purchase or acquisition of materials by the Town to be used to construct, repair or maintain any Town owned and/or maintained road or real property within the Town or (b) the performance of services for the Town to construct, repair or maintain any Town owned and/or maintained road or real property within the Town, the Bidder shall provide the following signed statement to the Town in its bid response, which shall be a certification under penalty of perjury by the Bidder:

    "The undersigned Bidder, _____, hereby submits a bid for materials, equipment and/or services for the Town of Glastonbury. The bid is for bid documents titled ***Air Conditioning Gideon Welles Elementary School.*** *The undersigned Bidder hereby certifies under penalty of perjury that in connection with the bid and, if it is awarded the purchase order or contract by the Town, in connection with any purchase order or contract: (1) no materials containing natural gas waste or oil waste from natural gas extraction activities or oil extraction activities shall be provided to the Town or shall be used in providing any services to the Town by the undersigned Bidder or any contractor, sub-contractor or agent of the undersigned Bidder; (b) nor will the undersigned Bidder or any contractor, subcontractor or agent of the undersigned Bidder apply any natural gas waste or oil waste from natural gas extraction activities or oil extraction activities to any publicly owned and/or maintained road or real property within the Town of Glastonbury in performing its obligations under the purchase order or contract. The undersigned Bidder hereby agrees and acknowledges that this requirement shall be a term of the purchase order or contract, if it awarded the purchase order or contract by the Town, and any breach of this provision shall be a breach of the purchase order or contract."*

24. For technical questions regarding this Bid, please contact David Sacchitella, Building Superintendent, at (860) 652-7706, email dave.sacchitella@glastonbury-ct.gov. For administrative questions regarding this Bid, please contact Mary F. Visone, Purchasing Agent at (860) 652-7588, email purchasing@glastonbury-ct.gov . The request must be received at least three (3) business days prior to the advertised response deadline. All questions, answers, and/or addenda, as applicable, will be posted on the Town's website at www.glastonbury-ct.gov (Upon entering the website click on Bids & Proposals Icon; click the Bid Title to view all bid details and document links). It is the respondent's responsibility to check the website for addenda prior to submission of any proposal**.**

IMPORTANT:

- Failure to comply with general rules may result in disqualification of the Bidder.
- Municipal projects are exempt from Federal Excise Taxes, as well as, State of Connecticut Sales, Use and Service Taxes and should not be include in the Bidder's proposal.

01.00 WORKMANSHIP, MATERIALS AND EMPLOYEES

01.01 Wherever in this contract the word "Engineer" is used, it shall be understood as referring to the Building Superintendent of the Town of Glastonbury acting personally or through any assistants/consultants duly authorized.

01.02 The entire work described herein shall be completed in accordance with the plans and specifications to the full intent and meaning of the same. Unless otherwise specified, all materials incorporated in the permanent work shall be new, and both workmanship and material shall be of good quality. The Contractor shall, if required, furnish satisfactory evidence as to the kind and quality of materials.

01.03 The wording "furnish", "install", "construct", "furnish and install", or any similar terms, unless specifically noted to the contrary, shall include all labor, materials, water, tools, equipment, light, power, transportation, and any other services required for the completion of the work.

01.04 The Contractor shall at all times enforce strict discipline and good order among his employees, and shall seek to avoid employing on the work any unfit person or anyone not skilled in the work assigned to him.

02.00 SUPERINTENDENT

02.01 The Contractor shall keep on the work during its progress, in the absence of the Contractor, a competent Superintendent. The Superintendent shall be acceptable to the Engineer and shall fully represent the Contractor. All directions given to the Superintendent shall be binding as if given to the Contractor.

03.00 PRECONSTRUCTION MEETING

03.01 A Preconstruction Meeting will be held with the Engineer, Contractor, and any other interested parties prior to commencing any work. The Engineer shall arrange the meeting based on a mutually convenient time.

04.00 PERMITS

04.01 All permits, licenses, and fees required for the performance of the Contract work shall be secured and paid for by the Contractor. The local building permit fees will be waived.

05.00 PROPERTY ACCESS

05.01 The Contractor shall take all proper precautions to protect from injury or unnecessary interference, and provide proper means of access to abutting property where the existing access is cut off by the Contractor.

05.02 The Contractor shall take all proper precautions to protect persons from injury or unnecessary inconvenience and leave an unobstructed way along the public and private places for travelers, vehicles, and access to hydrants.

05.03 The Contractor shall make arrangements with the adjacent property owners for such trespass as he may reasonably anticipate in the performance of the work. All such arrangements shall be reported, in writing, to the Engineer.

06.00 PROTECTION OF THE PUBLIC AND OF WORK AND PROPERTY

06.01 The Contractor shall continuously maintain adequate protection of all work from damage, and shall take all reasonable precautions to protect the Town from injury or loss arising in connection with the Contract.

06.02 The Contractor shall adequately protect adjacent private and public property as provided by law and the Contract Documents.

06.03 The Contractor shall make good any damage, injury, or loss of work and to the property of the Town resulting from lack of reasonable protective precautions.

06.04 The school building involved will be considered occupied while school is in session. The Contractor will be required to adjust his work schedule should the work have an adverse impact on school operations. There will be no modification of the bid price should a schedule adjustment be required.

07.00 EXISTING IMPROVEMENTS

07.01 The Contractor shall conduct his work so as to minimize damage to existing improvements designated to remain. Except where specifically stated otherwise in the specifications, drawings, or as directed by the Engineer, it will be the responsibility of the Contractor to restore to their original condition, as near as practical, all improvements on public or private property. This shall include:

a. Property within and adjacent to the work area such as shrubs, walks, driveways, fences, etc.

b. Utility mains, ducts, poles, and services. The Contractor is hereby notified that utilities, if/where shown on the plans, are at approximate locations. These locations are subject to possible errors in the source of information and errors in transcription. The Contractor shall make certain of the exact location of all mains, ducts, poles, and services prior to excavation.

08.00 SEPARATE CONTRACTS

08.01 The Engineer reserves the right to let other contracts in connection with this work. The Contractor shall afford other contractors reasonable opportunity for the introduction and storage of their materials and the execution of their work, and shall properly connect and coordinate his work with theirs. Wherever work being done by the Town of Glastonbury forces or by other contractors is contiguous to work covered by this Contract, the respective rights of the various interests involved shall be established by the Engineer to secure the completion of the various portions of the work.

09.00 INSPECTION OF WORK

09.01 The Town shall provide sufficient personnel for the inspection of the work.

09.02 The Engineer shall at all times have access to the work whenever it is in preparation or progress, and the Contractor shall provide proper facilities for such access and for inspection.

09.03 If the specifications or the Engineer's instructions require any work to be specially tested or approved, the Contractor shall give the Engineer timely notice of its readiness for inspection and, if the inspection is by another authority other than the Engineer, of the date fixed for such inspection. Inspections by the Engineer shall be made promptly. If any work should be covered up without approval or consent of the Engineer, it must, if required by the Engineer, be uncovered for examination and properly restored at the Contractor's expense.

09.04 Re-inspection of any work may be ordered by the Engineer. If such work is found to be in accordance with the Contract Documents, the Town shall pay the cost of re-inspection and replacement. If such work is not in accordance with the Contract Documents, the Contractor shall pay such cost.

10.00 RIGHT TO INCREASE OR DECREASE WORK

10.01 The Town shall have the right to increase or decrease the amount of work herein specified as may be required.

11.00 RIGHT OF ENGINEER TO STOP WORK FOR WEATHER CONDITIONS

11.01 Should the work, in the opinion of the Engineer, be in danger by reason of inclemency of weather, or could not be finished in time to prevent such danger, the Contractor shall cease operations upon order of the Engineer, and shall not resume them until ordered to do so by the Engineer when the weather conditions are favorable. The Contractor shall, upon such orders, discontinue work, remove all materials or appliances for or in use upon the work, and place the premises in proper condition for use by the public during the time the work is suspended as herein provided, without cost to the Town.

12.00 CONTRACTOR TO BE RESPONSIBLE FOR IMPERFECT WORK OR MATERIALS

12.01 Any faithful work or imperfect material that may be discovered before the acceptance and the payment of the work shall be corrected upon the order of the Engineer. The acceptance and payment of the work does not in any manner relieve the Contractor of his obligation to construct work in the proper manner and the use of materials herein specified.

13.00 TOWN MAY NOTIFY CONTRACTOR IF WORK IS NOT CARRIED ON SATISFACTORILY

13.01 If, in the opinion of the Engineer, the Contractor is not proceeding with the work at a sufficient rate of progress so as to finish in the time specified, or has abandoned said work, or is not complying with the terms and stipulations or the Contract and specifications, the Engineer may serve notice on the Contractor to adopt such methods as will ensure the completion of the work in the time specified.

13.02 If, within five days after the Engineer has notified the Contractor that his work is not being carried on satisfactorily as before mentioned, the Engineer shall have the right to annul the

Contract and manage the work under the direction of the Engineer, or re-let, for the very best interest of the Town as a new contract, the work under said new Contract shall be considered the responsibility of the defaulting Contractor.

13.03 Additional costs incurred over and above the original Contract shall be borne by the Performance Bond.

14.00 DEDUCTIONS FOR UNCORRECTED WORK

14.01 If the Engineer deems it inexpedient to correct work that has been damaged or that was not done in accordance with the Contract, an equitable deduction from the Contract price shall be made there for.

14.02 The Contractor shall promptly remove from the premises all materials condemned by the Engineer as failing to meet Contract requirements, whether incorporated in the work or not, and the Contractor shall promptly replace and re-execute his own work in accordance with the Contract and without expense to the Town, and shall bear the expense of making good all work by other contractors destroyed or damaged by such removal or replacement.

14.03 If the Contractor does not remove such condemned work and materials as promptly as possible after written notice, the Engineer may remove them and store the materials at the expense of the Contractor.

15.00 CLEANING UP

15.01 The Contractor must remove all debris of every description as the work progresses and leave the surroundings in a neat and orderly condition to the satisfaction of the Engineer.

15.02 Upon completion, and before acceptance and final payment, the Contractor shall remove from the site all equipment, forms, surplus material, rubbish and miscellaneous debris and leave the site in a neat and presentable condition.

16.00 ROYALTIES AND PATENTS

16.01 The Contractor shall pay all royalties and license fees. He shall defend all suits or claims for infringement of any patent rights and shall save the Town of Glastonbury harmless from loss on account hereof, except that the Town of Glastonbury shall be responsible for all such loss when a particular manufacturer, product, or process is specified by the Town of Glastonbury.

17.00 ERRORS OR CONFLICT IN DRAWINGS AND SPECIFICATIONS

17.01 The Contractor shall immediately notify the Owner/Engineer should he find any errors or conflicts in the contract documents. The Owner/Engineer shall render his interpretation or instruction in writing on the items as soon as possible.

17.02 Any work undertaken by the Contractor containing possible errors or conflicts will be done at his own risk unless he has received prior written approval from the Owner/Engineer.

17.03 The Contractor shall be responsible for estimating and supplying all quantities, and where clarification or additional information is required, a request in writing to the Owner/Engineer shall be made. No extra charge or compensation will be allowed the Contractor unless there is a change in scope or dimension of the project resulting in need for extra material, equipment and/or labor. Said differences are to be handled under Article 18.

18.00 EXTRA WORK AND EXTRA COST

18.01 The Owner, without invalidating the contract documents, may order extra work or make changes by altering, adding to or deducting from the work, the contract price being adjusted accordingly. All such work shall be executed under the conditions of the original contract except that any claim of extension of time caused thereby shall be adjusted at the time of ordering the change.

18.02 No extra work or change shall be performed unless in pursuance of a written order from the Owner/Engineer, with the agreed price prior to the commencement of the work, and no claim for an addition to the contract price shall be valid unless so ordered. All extra work requests shall include detailed labor, material and mark up costs to be considered.

18.03 The value of any such work or change shall be determined, in one or more of the following ways:

a) By unit prices named in the contract or subsequently agreed upon.
b) By cost and percentage or by cost and a final fee.

19.00 SUBSTITUTIONS

19.01 The Contractor shall use materials as specified unless material list is of an open nature. Material other than specified will be permitted only after written application, including four (4) copies of specifications, is made by the Contractor and written approval received from the Engineer or Owner. It is the Contractor's responsibility to demonstrate clearly how the substitution is equal to or better than the specified and associated cost savings to Town.

The material installed in the job site shall be new and of the quality specified.

The manufacturer's recommendation shall be followed for the installation of all equipment.

20.00 PRODUCT SUBMITTALS

20.01 Prior to ordering materials, the Contractor shall submit submittals as specified in the detailed specification sections. Three (3) copies of the submittals shall be forwarded to the Engineer for review and approval.

20.02 Submittals shall indicate specification Section for each product. Submittals not containing all the required information shall be returned to the contractor for re-submittal.

21.00 OWNER'S ACCEPTANCE

21.01 Within seven (7) days of the Contractor's notification that the installation is substantially complete, the Owner's authorized representative shall inspect the installation. The Owner, with the Contractor, shall take necessary steps to inspect the installation. Upon completion of the

inspection, the Owner or the Owner's authorized representative may either accept the work outright or prepare a "Punch List" that upon completion by the Contractor and acceptance by the Owner will signify final acceptance provided that all other applicable terms and provisions of the Contract have been completed to the Owner's satisfaction.

22.00 RESPONSIBILITY FOR MAINTENANCE

22.01 It will be the Contractor's responsibility to maintain the work as specified in the detailed specifications during the warranty period.

23.00 SERVICE BY THE CONTRACTOR

23.01 The Contractor shall maintain the work as specified during the warranty period.

24.00 WARRANTY

24.01 The guarantee shall be as specified in the respective sections of the specification.

24.02 The Contractor shall be responsible for the repair and/or replacement of all defective work and materials. All repair work shall be completed in a timely fashion.

24.03 Should the Contractor not respond promptly, the Owner may take any action he deems necessary to repair the defect and prevent further damage to his property, including the hiring of another contractor, or the repairing of such a defect with material supplied by the Contractor. In this event, the Contractor shall be liable for expenses incurred and property damages suffered by the Owner.

01.00 NOTICE TO CONTRACTOR

01.01 Intent of Contract: The intent of the Contract is to prescribe a complete work or improvement which the Contractor undertakes to do, in full compliance with the specifications, plans, special provisions, proposal and Contract. The Contractor shall perform all work in close conformity with the plans or as modified by written orders, including the furnishing of all materials, supplies, transportation, labor, and all other things necessary to the satisfactory prosecution and completion of the project.

The scope of the work shall include all labor, materials and equipment needed to provide and install VRF Air Conditioning systems and associated materials, complete and ready for use, as described in the plans and specifications for Air Conditioning Installation in Gideon Welles School in Glastonbury, CT.

02.00 COMMUNICATIONS

02.01 All notices, demands, requests, instructions, approvals, proposals, and claims must be in writing.

02.02 Any notice to, or demand upon, the Contractor shall be sufficiently given if delivered at the office of the Contractor stated on the signature page of the Agreement (or at such other office as the Contractor may, from time to time, designate) in a sealed, postage-prepaid envelope or delivered with charges prepaid to any telegraph company for transmission, in each case addressed to such office.

02.03 All papers required to be delivered to the Town shall, unless otherwise specified in writing to the Contractor, be delivered to the Building Superintendent, 2143 Main Street, Glastonbury, CT 06033, and any notice to, or demand upon, the Town shall be delivered at the above address in a sealed, postage-prepaid envelope or delivered with charges prepaid to any telegraph company for transmission, in each case addressed to such office or to such other representatives of the Town, or to such other address as the Town may subsequently specify in writing to the Contractor for such purpose.

02.04 Any such notice shall be deemed to have been given as of the time of actual delivery or, in case of mailing, when the same should have been received in due course of post or, in the case of telegrams, at the time of actual receipt, as the case may be.

03.00 WORK BY OTHERS

03.01 Private utilities, contractors, developers or other parties may be expected to be working within the Contract area during this Contract. It shall be the responsibility of the contractor to coordinate his work with the work being done by others in order that the construction shall proceed in an efficient and logical manner. The Contractor shall have no claim or claims whatever against the Town, the Engineer, or other parties due to delays or other reasons caused by the work by others or his failure to coordinate such work.

04.00 CONTRACTOR'S WORK AND STORAGE AREA

04.01 The Contractor shall contact the Town to determine if any specific locations will be designated, or gain its approval prior to using any area for storage of equipment, materials and trailers during

the period of this Contract. The Contractor shall confine his work/storage area to the limits as designated or approved and shall be responsible for the security of the work/storage area. Upon completion of the Contract, the Contractor shall remove all equipment and materials, except as otherwise specified, and restore the site to its original condition as approved by the Engineer and at no cost to the Town.

05.00 DISPOSAL AREA

05.01 The Tryon Street Bulky Waste Facility will be available to the Contractor, at no charge, for disposal of materials that are accepted at that facility. No materials containing lead-based paint of any level shall be dumped at the Tryon Street facility. The Contractor is required to obtain a disposal area for all other unsuitable or surplus materials at no cost to the Town.

06.00 DUST CONTROL

06.01 During the progress of the work, the Contractor shall conduct his operations and maintain the area of his activities so as to minimize the creation and dispersion of dust. If the Engineer decides that it is necessary to use water or calcium chloride for more effective dust control, the Contractor shall furnish and spread the material, as directed, without additional compensation.

07.00 PROTECTION OF EXISTING UTILITIES

07.01 Before starting any excavation, the Contractor shall submit to the Engineer plans or details showing the proposed method the Contractor will use to support and protect all existing utilities during construction. The furnishing of such plans and details shall not serve to relieve the Contractor of any responsibility for the proper conduct of the work.

07.02 There will be no extra payment for submitting plans or details for supporting and protecting all existing utilities during construction.

08.00 TIME FOR COMPLETION/NOTICE TO PROCEED

08.01 Within ten (10) calendar days after the date of the Notice of Award, the Contractor must provide the appropriate insurance certificates to the Town Purchasing Agent and shall be issued a Notice to Proceed and a Purchase Order prior to initiating any work on the project.

08.02 Work shall commence within fifteen (15) days of the date of the Notice to Proceed/Purchase Order.

08.03 After the work has begun, it will continue in an orderly fashion and shall be fully completed by the date indicated below. The Engineer reserves the right to extend the contract an additional thirty (30) days by mutual written agreement.

08.04 It is the intention of the Town to have all work required under this Contract completed no later than August 1, 2019. In no case, however, shall the work be completed any later than August 17, 2019.

08.05 Because the facilities remain available to Board of Education custodial and maintenance staff during the installation period, the Contractor shall make every reasonable effort to complete the installation as expeditiously as possible.

09.00 MEASUREMENT AND PAYMENT

09.01 All direct, indirect, or incidental costs of work and/or services required by these specifications shall be included in the Lump Sum price.

09.02 Monthly progress payments will be made, based on the approved Schedule of Values, for work that has progressed in accordance with the contract documents, subject to a deduction of five percent (5%) of the amount of the application for payment to be retained by the Owner until completion of the entire contract in an acceptable manner and two and one half percent (2.5%) until the applicable one year warranty period has expired and all required inspections have been completed and results have been submitted and approved by the Engineer.

10.00 COMPLIANCE WITH APPLICABLE FEDERAL, STATE AND LOCAL REQUIREMENTS

10.01 This award of bid is subject to the conformance of the Contractor to all Federal, State, and Local laws, statutes, regulations, ordinances or other requirements that are applicable to the type of work contained in these specifications.

INSURANCE

The Bidder shall, at its own expense and cost, obtain and keep in force during the entire duration of the Project or Work the following insurance coverage covering the Bidder and all of its agents, employees and sub-contractors and other providers of services and shall name the **Town of Glastonbury and Board of Education and their employees and agents as an Additional Insured** on a primary and non-contributory basis to the Bidders Commercial General Liability and Automobile Liability policies. **These requirements shall be clearly stated in the remarks section on the Bidders Certificate of Insurance.** Insurance shall be written with insurance carriers approved in the State of Connecticut and with a minimum Best's Rating of A-VIII. In addition, all carriers are subject to approval by the Town. Minimum Limits and requirements are stated below:

1) Worker's Compensation Insurance:
- Statutory Coverage
- Employer's Liability
- $500,000 each accident/$500,000 disease-policy limit/$500,000 disease each employee
- A Waiver of Subrogation shall be provided in favor of the Town of Glastonbury and Board of Education and their employees and agents.

2) Commercial General Liability:
- Including Premises & Operations, Products and Completed Operations, Personal and Advertising Injury, Contractual Liability and Independent Contractors.
- Limits of Liability for Bodily Injury and Property Damage
  Each Occurrence $1,000,000
  Aggregate $2,000,000 (The Aggregate Limit shall apply separately to each job.)
- A Waiver of Subrogation shall be provided in favor of the Town of Glastonbury and Board of Education and their employees and agents.

3) Automobile Insurance:
- Including all owned, hired, borrowed and non-owned vehicles
- Limit of Liability for Bodily Injury and Property Damage: Per Accident $1,000,000
- A Waiver of Subrogation shall be provided in favor of the Town of Glastonbury and Board of Education and their employees and agents.

The Bidder shall direct its Insurer to provide a Certificate of Insurance to the Town before any work is performed. The Contractor shall be responsible to notify the Town 60 days in advance with written notice of cancellation or non-renewal. The Certificate shall evidence all required coverage. The Bidder shall provide the Town copies of any such insurance policies upon request.

INDEMNIFICATION

To the fullest extent permitted by law, the Bidder shall indemnify and hold harmless the Town of Glastonbury and Board of Education, their consultants, agents, and employees from and against all claims, damages, losses and expenses, direct, indirect or consequential (including but not limited to fees and charges of engineers, attorneys and other professionals and court and arbitration costs) to the extent arising out of or resulting from the performance of the Bidder's work, provided that such claim, damage, loss or expense is caused in whole or in part by any negligent act or omission by the Bidder, or breach of its obligations herein or by any person or organization directly or indirectly employed or engaged by the Bidder to perform or furnish either of the services, or anyone for whose acts the Bidder may be liable.

ATTENTION CONTRACTOR

☐APPROVED FORM FOR YOUR FILES-NOTE ANY COMMENTS BOTTOM OF PAGE 2 – APPROVAL REQUIREMENTS

☐APPLICATION DENIED-SEE BOTTOM PAGE 2

GLASTONBURY PUBLIC SCHOOLS

OFFICE OF DIRECTOR OF ENVIRONMENTAL HEALTH AND SAFETY

Dr. Kenneth Roy
Safety Compliance Officer
Director of Environmental Health and Chemical Safety
Email: royk@glastonburyus.org

Glastonbury High School
330 Hubbard Street
Glastonbury, CT 06033
Phone (860) 652-7200 Ext. 12002
Fax: (860) 652-7275

CONTRACTOR COMPLIANCE PERMIT APPLICATION

Notice to Contractors:
In concert with, but not limited to, all OSHA General Industry and Construction standards, EPA, NFPA, AHERA, and building codes, contractors conducting work activities at/on any Glastonbury Public Schools District property are required to provide the following information to Lori Pacifici (pacificil@glastonburyus.org).

NOTICE: **THIS FORM MUST BE COMPLETED AND APPROVED 3 DAYS PRIOR TO COMMENCING ANY OPERATIONS. ALL CONTRACTORS AND SUB CONTRACTORS MUST SUBMIT THEIR OWN PERMIT APPLICATION.**

Once approved, the form will be returned to the originator. Approval is conditional relative to noted specifications by Director of Environmental Health and Chemical Safety.

1. Project Information:

Project Description:

Location:		
Start Date:	**Completion Date:**	
Contractor Safety Officer	**Phone:**	**Fax:** **Email:**

Permit Prepared By: **Date Prepared:**

Project Scope	**Yes**	**No**	**Comments**
Confined Spaces*	☐	☐	
Electrical Work**	☐	☐	
Forklift	☐	☐	
Hazardous Materials	☐	☐	
Ladders/Scaffolds	☐	☐	
Respirators	☐	☐	
Rigging/Lifting***	☐	☐	
Welding***	☐	☐	
Asbestos Management**	☐	☐	

Polychlorinated Biphenyls (PCBs) Management – Gideon Welles School only ******	☐	☐	

* Contractors need to secure, complete and submit a "Confined Space Permit" from a GPS safety compliance officer for approval **3 days PRIOR** to doing any work in a Permit Required Confined Space Area.

** Contractors need to secure, complete and submit an "Energized Electrical Work Permit" from a GPS safety compliance officer for approval **3 days PRIOR** to doing any energized electrical work.

*** Contractors are required to secure, complete and submit a "Hot Work Permit" from a GPS safety compliance officer for approval **3 days PRIOR** to doing any hot work (e.g., welding, etc.).

**** Contractors need to secure the Asbestos Management Plan from the Director of Environmental Health & Chemical Safety prior to all construction/demolition work.

***** A safety plan must be submitted and approved for use of cranes. Copies of current completion documents or certifications of training/operation must be provided.

****** Contractors need to secure the PCB Management Plan from the Director of Environmental Health & Chemical Safety prior to all construction/demolition work at Gideon Welles.

2. Provide completion documentation with issuance date for 10-hour OSHA construction safety and health course for any contracted employee working on GPS site. Additional training certificates may be required.
3. Provide district safety officer with Safety Data Sheets (SDS) for all materials used on-site.

LIST EITHER CHEMICAL OR TRADE NAME OF EACH ATTACHED SDS SHEET BELOW	

4. In cases of hazardous waste production, a written disposal plan must be provided to and approved by the district safety officers, 5 days prior to initiation of work for those materials disposed of on site.
5. All contractors and/or their personnel are required to be in compliance with all EPA, NFPA, AHERA and OSHA and other appropriate safety standards when working on site (under the direction of a contractor's project supervisor).
6. All on-site activities carried out by contractors, and/or their employees, must be done in such a manner as to maintain a safer working environment for all Glastonbury Public Schools' employees, students and visitors.
7. Contractor employees found to be in non-compliance may be removed from the District worksite by the District Safety Officer.
8. Contractors found to be in non-compliance will be subject to forfeiture of payment and/or contract termination.
9. The district reserves the right to inspect the worksite at any time for safety compliance.
10. The district may require review of a contractors OSHA 200/300 log for a period of three (3) previous years.
11. A Copy of the "Completion Document" for 10 Hour OSHA training within the last five years for contractor employees working on-site must be provided.

Please type company name and address below

	RETURN TO: Lori Pacifici Secretary – Safety Compliance Office E-mail: pacificil@glastonburyus.org

By signature, the contractor agrees to adhere to all components and the spirit of this document.		
Signature of Contractor	Title	Date

INTERNAL USE ONLY
APPROVAL STATUS:

Dr. Kenneth Roy
Director of Environmental Health & Chemical Safety

_____ Date:
Signature

☐ YES
☐ NO

cc: ☐ Building Principal/Supervisor
☐ Contractor
☐ Maintenance Office File
☐ Director of Environmental Health and Chemical Safety
- Dr. Kenneth Roy
☐ Safety Compliance Officer – Dr. Jill Carey
☐ Other

Revised: 7/18/18

NOTE TO CONTRACTOR: APPROVAL CONTINGENT ON THE FOLLOWING ITEMS:

SCHOOL YEAR AT A GLANCE

GLASTONBURY PUBLIC SCHOOLS

2018

SCHOOL BEGINS: AUG 29 Grs. 7-12
SCHOOL BEGINS: AUG 30 Grs. K-6

M	T	W	TH	F

AUGUST 2018

Gr. 7-12 3 Days
Gr. K-6 2 Days

		1	2	3
6	7	8	9	10
13	14	15	16	17
20	21	22	23	24
27	28	29	30	31

SEPTEMBER 2018

17 DAYS

3	4	5	6	7
10	11	12	13	14
17	18	19	20	21
24	25	26	27	28

OCTOBER 2018

22 DAYS

1	2	3	4	5
8	9	10	11	12
15	16	17	18	19
22	23	24	25	26
29	30	31		

NOVEMBER 2018

19 DAYS

			1	2
5	6	7	8	9
12	13	14	15	16
19	20	21	22	23
26	27	28	29	30

DECEMBER 2018

15 DAYS

3	4	5	6	7
10	11	12	13	14
17	18	19	20	21
24	25	26	27	28
31				

JANUARY 2019

Gr 7-12 20 DAYS
Gr. K-6 21 DAYS

	1	2	3	4
7	8	9	10	11
14	15	16	17	18
21	22	23	24	25
28	29	30	31	

Approved: 10.16.17

AUG 27	Teacher Work Day-Convocation
AUG 28	Teacher Professional Development
AUG 29	**FIRST DAY OF SCHOOL, GRADES 7-12** Teacher Work Day, Grades K-6
AUG 30	**FIRST DAY OF SCHOOL, GRADES K-6** **FULL DAY**
SEPT 3	Labor Day
SEPT 10	Rosh Hashanah
SEPT 19	Yom Kippur
OCT 8	Columbus Day
NOV 6	Election Day - No School for Students
NOV 21	Early Dismissal
NOV 22-23	Thanksgiving Recess
DEC 24-JAN 1	Holiday Recess (Includes New Year's Day)
JAN 21	Martin Luther King Day
JAN 17-23	Grades 7-12: Mid-Term Exams (Early Dismissal Grades 9-12 only)
JAN 24	Gr. 7-12 No School for Students Teacher Work Day, Grades 7-12
FEB 18-19	Winter Recess (includes Presidents' Day)
APR 15-19	Spring Recess (Includes Good Friday)
MAY 27	Memorial Day
Last 4 Days	Final Exams, Grades 7-12 (Early Dismissal Grades 7-12)
Last Day	**Projected Last Day – June 10** Early Dismissal Grades K-12
	Projected Teacher Work Day – June 11 Teacher Work Day will be the first work day following the last day for students.
	SCHOOL CLOSED

2019

Projected Last Day – June 10, 2019

M	T	W	TH	F

FEBRUARY 2019

18 DAYS

				1
4	5	6	7	8
11	12	13	14	15
18	19	20	21	22
25	26	27	28	

MARCH 2019

21 DAYS

				1
4	5	6	7	8
11	12	13	14	15
18	19	20	21	22
25	26	27	28	29

APRIL 2019

17 DAYS

1	2	3	4	5
8	9	10	11	12
15	16	17	18	19
22	23	24	25	26
29	30			

MAY 2019

22 DAYS

		1	2	3
6	7	8	9	10
13	14	15	16	17
20	21	22	23	24
27	28	29	30	31

JUNE 2019

DAYS 6

3	4	5	6	7
10	11	12	13	14
17	18	19	20	21
24	25	26	27	28

*SCHOOL ENDS JUNE 10

*If weather or other emergencies require the closing of school, the lost days will be made up by extending the school year in June up to 9 days.
If additional days are needed, they will be taken from the Spring Recess, beginning April 15.

TOWN OF GLASTONBURY * 2155 MAIN STREET * GLASTONBURY * CT

BID / PROPOSAL NO: **GL-2019-16** **DATE DUE:** **01-10-19**

DATE ADVERTISED: **12-12-18** **TIME DUE:** **11:00 AM**

NAME OF PROJECT: **Air Conditioning Installation at Gideon Welles Elementary School**

In compliance with this Invitation to Bid, the Bidder hereby proposes to provide goods and/or services as per this solicitation in strict accordance with the Bid Documents, within the time set forth therein, and at the prices submitted with their bid response.

It is the responsibility of the Bidder to clearly mark the outside of the bid envelope with the Company name and Address, Bid Number, Date and Time of Bid Opening, and it also THE RESPONSIBILITY OF THE BIDDER TO CHECK THE TOWN'S WEBSITE BEFORE SUBMITTING BID FOR ADDENDA POSTED PRIOR TO BID OPENING.

THE BIDDER ACKNOWLEDGES RECEIPT OF THE FOLLOWING ADDENDA AS REQUIRED:

Addendum #1 _____(Initial/Date) **Addendum #2** _____ (Initial/Date) **Addendum #3** _____(Initial/Date)

Other Items Required with Submission of Bid Proposal
The following bid checklist describes items required for inclusion with the above-referenced bid proposal package. It is provided for the convenience of the bidders and, therefore, should not be assumed to be a complete list.

_____ Bid Bond (10% of total bid amount).

_____ List of five (5) similar projects completed within last three (3) years.

_____ Acknowledgement of Addendums (as applicable).

_____ Acknowledgement of Code of Ethics on Bid Proposal page.

_____ Sealed bids, one original and one copy. Clearly marked envelope with Bid Number, Date, Time of opening, Bidder's Company Name and address.

_____ Disclosure of past and pending mediation, arbitration and litigation cases that the Bidder or its principals have been involved in for the most recent five years (if applicable).

_____ Copy of State of Connecticut HVAC contractor's license

_____ Included Affidavit in compliance with Town ordinance prohibiting natural gas waste & oil waste from natural gas extraction activities or oil extraction activities as per Section 23 of the Information for Bidders.

Name of Bidder: _____

LUMP SUM BID:

Furnish and install Air Conditioning Gideon Welles Elementary School as specified in the Plans and Specifications for Bid No. GL-2019-16:

TOTAL OF LUMP SUM BID AMOUNT $_____
(Numeric Bid Amount)

_____
(Written Bid Amount)

MANUFACTURER: _____

Please confirm your company has the resources to complete the project by August 1, 2019**:**
_____Yes _____No

NON-COLLUSION AFFIDAVIT:
By submission of this bid, the Bidder certifies, and in the case of a joint bid each party thereto certifies as to their own organization that this bid has been arrived at independently without consultation, communication, or agreement as to any matter relating to this bid with any other Bidder or with any competitor.

CODE OF ETHICS:
I / We have reviewed a copy of the Town of Glastonbury's Code of Ethics and agree to submit a Consultant Acknowledgement Form if I /We are selected. Yes _____ No _____ *

***Bidder is advised that effective August 1, 2003, the Town of Glastonbury cannot consider any bid or proposal where the bidder has not agreed to the above statement.**

Print Name, Title of Individual	**Doing Business as (Trade Name)**
Signature of Individual	**Street Address**
Date	**City, State, Zip Code**
E:mail Address	**Telephone Number / Fax Number**

(Seal – If bid is by a Corporation)
Attest

Minimum Rates and Classifications for Building Construction

ID# : B 25446

Connecticut Department of Labor
Wage and Workplace Standards Division

By virtue of the authority vested in the Labor Commissioner under provisions of Section 31-53 of the General Statutes of Connecticut, as amended, the following are declared to be the prevailing rates and welfare payments and will apply only where the contract is advertised for bid within 20 days of the date on which the rates are established. Any contractor or subcontractor not obligated by agreement to pay to the welfare and pension fund shall pay this amount to each employee as part of his/her hourly wages.

Project Number: GL-2019-16
Project Town: Glastonbury
State#:
FAP#:

Project: Gideon Welles School Air Conditioning Installation

CLASSIFICATION	Hourly Rate	Benefits
1a) Asbestos Worker/Insulator (Includes application of insulating materials, protective coverings, coatings, & finishes to all types of mechanical systems; application of firestopping material for wall openings & penetrations in walls, floors, ceilings	38.25	27.96
1b) Asbestos/Toxic Waste Removal Laborers: Asbestos removal and encapsulation (except its removal from mechanical systems which are not to be scrapped), toxic waste removers, blasters.**See Laborers Group 7**		
1c) Asbestos Worker/Heat and Frost Insulator	40.21	29.30

As of: **Wednesday, December 05, 2018**

2) Boilermaker	38.34	26.01
3a) Bricklayer, Cement Mason, Concrete Finisher (including caulking), Stone Masons	33.48	32.06 + a
3b) Tile Setter	34.90	25.87
3c) Terrazzo Mechanics and Marble Setters	31.69	22.35
3d) Tile, Marble & Terrazzo Finishers	26.70	21.75
3e) Plasterer	33.48	32.06

As of: **Wednesday, December 05, 2018**

Project: Gideon Welles School Air Conditioning Installation

------LABORERS------

4) Group 1: Laborers (common or general), acetylene burners, carpenter tenders, concrete specialists, wrecking laborers, fire watchers.	30.05	20.10
4a) Group 2: Mortar mixers, plaster tender, power buggy operators, powdermen, fireproofer/mixer/nozzleman (Person running mixer and spraying fireproof only).	30.30	20.10
4b) Group 3: Jackhammer operators/pavement breaker, mason tender (brick), mason tender (cement/concrete), forklift operators and forklift operators (masonry).	30.55	20.10
4c) **Group 4: Pipelayers (Installation of water, storm drainage or sewage lines outside of the building line with P6, P7 license) (the pipelayer rate shall apply only to one or two employees of the total crew who primary task is to actually perform the mating of pipe sections) P6 and P7 rate is $26.80.	30.55	20.10
4d) Group 5: Air track operator, sand blaster and hydraulic drills.	30.55	20.10

4e) Group 6: Blasters, nuclear and toxic waste removal.	31.80	20.10
4f) Group 7: Asbestos/lead removal and encapsulation (except it's removal from mechanical systems which are not to be scrapped).	31.05	20.10
4g) Group 8: Bottom men on open air caisson, cylindrical work and boring crew.	28.38	20.10
4h) Group 9: Top men on open air caisson, cylindrical work and boring crew.	27.86	20.10
4i) Group 10: Traffic Control Signalman	16.00	20.10
5) Carpenter, Acoustical Ceiling Installation, Soft Floor/Carpet Laying, Metal Stud Installation, Form Work and Scaffold Building, Drywall Hanging, Modular-Furniture Systems Installers, Lathers, Piledrivers, Resilient Floor Layers.	32.60	25.34

As of: **Wednesday, December 05, 2018**

5a) Millwrights	33.14	25.74
6) Electrical Worker (including low voltage wiring) (Trade License required: E1,2 L-5,6 C-5,6 T-1,2 L-1,2 V-1,2,7,8,9)	40.00	25.97+3% of gross wage
7a) Elevator Mechanic (Trade License required: R-1,2,5,6)	51.71	32.645+a+b
-----LINE CONSTRUCTION----		
Groundman	26.50	6.5% + 9.00
Linemen/Cable Splicer	48.19	6.5% + 22.00

As of: **Wednesday, December 05, 2018**

8) Glazier (Trade License required: FG-1,2)	37.18	21.05 + a
9) Ironworker, Ornamental, Reinforcing, Structural, and Precast Concrete Erection	35.47	35.14 + a
----OPERATORS----		
Group 1: Crane handling or erecting structural steel or stone, hoisting engineer 2 drums or over, front end loader (7 cubic yards or over), work boat 26 ft. and over and Tunnel Boring Machines. (Trade License Required)	39.55	24.05 + a
Group 2: Cranes (100 ton rate capacity and over); Excavator over 2 cubic yards; Piledriver ($3.00 premium when operator controls hammer); Bauer Drill/Caisson. (Trade License Required)	39.23	24.05 + a
Group 3: Excavator; Backhoe/Excavator under 2 cubic yards; Cranes (under 100 ton rated capacity), Grader/Blade; Master Mechanic; Hoisting Engineer (all types of equipment where a drum and cable are used to hoist or drag material regardless of motive power of operation), Rubber Tire Excavator (Drott-1085 or similar);Grader Operator; Bulldozer Fine Grade. (slopes, shaping, laser or GPS, etc.). (Trade License Required)	38.49	24.05 + a

Group 4: Trenching Machines; Lighter Derrick; Concrete Finishing Machine; CMI Machine or Similar; Koehring Loader (Skooper).	38.10	24.05 + a
Group 5: Specialty Railroad Equipment; Asphalt Paver; Asphalt Reclaiming Machine; Line Grinder; Concrete Pumps; Drills with Self Contained Power Units; Boring Machine; Post Hole Digger; Auger; Pounder; Well Digger; Milling Machine (over 24" Mandrell)	37.51	24.05 + a
Group 5 continued: Side Boom; Combination Hoe and Loader; Directional Driller; Pile Testing Machine.	37.51	24.05 + a
Group 6: Front End Loader (3 up to 7 cubic yards); Bulldozer (rough grade dozer).	37.20	24.05 + a
Group 7: Asphalt roller, concrete saws and cutters (ride on types), vermeer concrete cutter, Stump Grinder; Scraper; Snooper; Skidder; Milling Machine (24" and under Mandrell).	36.86	24.05 + a
Group 8: Mechanic, grease truck operator, hydroblaster; barrier mover; power stone spreader; welding; work boat under 26 ft.; transfer machine.	36.46	24.05 + a

As of: **Wednesday, December 05, 2018**

Group 9: Front end loader (under 3 cubic yards), skid steer loader regardless of attachments, (Bobcat or Similar): forklift, power chipper; landscape equipment (including Hydroseeder).	36.03	24.05 + a
Group 10: Vibratory hammer; ice machine; diesel and air, hammer, etc.	33.99	24.05 + a
Group 11: Conveyor, earth roller, power pavement breaker (whiphammer), robot demolition equipment.	33.99	24.05 + a
Group 12: Wellpoint operator.	33.93	24.05 + a
Group 13: Compressor battery operator.	33.35	24.05 + a
Group 14: Elevator operator; tow motor operator (solid tire no rough terrain).	32.21	24.05 + a

Group 15: Generator Operator; Compressor Operator; Pump Operator; Welding Machine Operator; Heater Operator.	31.80	24.05 + a
Group 16: Maintenance Engineer/Oiler.	31.15	24.05 + a
Group 17: Portable asphalt plant operator; portable crusher plant operator; portable concrete plant operator.	35.46	24.05 + a
Group 18: Power safety boat; vacuum truck; zim mixer; sweeper; (Minimum for any job requiring a CDL license).	33.04	24.05 + a
------PAINTERS (Including Drywall Finishing)------		
10a) Brush and Roller	33.62	21.05

10b) Taping Only/Drywall Finishing	34.37	21.05
10c) Paperhanger and Red Label	34.12	21.05
10e) Blast and Spray	36.62	21.05
11) Plumber (excluding HVAC pipe installation) (Trade License required: P-1,2,6,7,8,9 J-1,2,3,4 SP-1,2)	42.62	31.21
12) Well Digger, Pile Testing Machine	37.26	24.05 + a
13) Roofer (composition)	36.70	19.85

As of: **Wednesday, December 05, 2018**

14) Roofer (slate & tile)	37.20	19.85
15) Sheetmetal Worker (Trade License required for HVAC and Ductwork: SM-1,SM-2,SM-3,SM-4,SM-5,SM-6)	37.50	36.79
16) Pipefitter (Including HVAC work) (Trade License required: S-1,2,3,4,5,6,7,8 B-1,2,3,4 D-1,2,3,4, G-1, G-2, G-8 & G-9)	42.62	31.21
------TRUCK DRIVERS------		
17a) 2 Axle	29.13	23.33 + a
17b) 3 Axle, 2 Axle Ready Mix	29.23	23.33 + a

17c) 3 Axle Ready Mix	29.28	23.33 + a
17d) 4 Axle, Heavy Duty Trailer up to 40 tons	29.33	23.33 + a
17e) 4 Axle Ready Mix	29.38	23.33 + a
17f) Heavy Duty Trailer (40 Tons and Over)	29.58	23.33 + a
17g) Specialized Earth Moving Equipment (Other Than Conventional Type on-the-Road Trucks and Semi-Trailers, Including Euclids)	29.38	23.33 + a
18) Sprinkler Fitter (Trade License required: F-1,2,3,4)	43.92	15.84 + a

As of: **Wednesday, December 05, 2018**

19) Theatrical Stage Journeyman	25.76	7.34

Welders: Rate for craft to which welding is incidental.

**Note: Hazardous waste removal work receives additional $1.25 per hour for truck drivers.*

***Note: Hazardous waste premium $3.00 per hour over classified rate*

ALL Cranes: When crane operator is operating equipment that requires a fully licensed crane operator to operate he receives an extra $4.00 premium in addition to the hourly wage rate and benefit contributions:

1) Crane handling or erecting structural steel or stone; hoisting engineer (2 drums or over)

2) Cranes (100 ton rate capacity and over) Bauer Drill/Caisson

3) Cranes (under 100 ton rated capacity)

Crane with 150 ft. boom (including jib) - $1.50 extra
Crane with 200 ft. boom (including jib) - $2.50 extra
Crane with 250 ft. boom (including jib) - $5.00 extra
Crane with 300 ft. boom (including jib) - $7.00 extra
Crane with 400 ft. boom (including jib) - $10.00 extra

All classifications that indicate a percentage of the fringe benefits must be calculated at the percentage rate times the "base hourly rate".

Apprentices duly registered under the Commissioner of Labor's regulations on "Work Training Standards for Apprenticeship and Training Programs" Section 31-51-d-1 to 12, are allowed to be paid the appropriate percentage of the prevailing journeymen hourly base and the full fringe benefit rate, providing the work site ratio shall not be less than one full-time journeyperson instructing and supervising the work of each apprentice in a specific trade.

The Prevailing wage rates applicable to this project are subject to annual adjustments each July 1st for the duration of the project.

Each contractor shall pay the annual adjusted prevailing wage rate that is in effect each July 1st, as posted by the Department of Labor.

It is the contractor's responsibility to obtain the annual adjusted prevailing wage rate increases directly from the Department of Labor's website.

The annual adjustments will be posted on the Department of Labor's Web page: www.ct.gov/dol. For those without internet access, please contact the division listed below.

The Department of Labor will continue to issue the initial prevailing wage rate schedule to the Contracting Agency for the project.

All subsequent annual adjustments will be posted on our Web Site for contractor access.

Contracting Agencies are under no obligation pursuant to State labor law to pay any increase due to the annual adjustment provision.

As of: **Wednesday, December 05, 2018**

Project: Gideon Welles School Air Conditioning Installation

Effective October 1, 2005 - Public Act 05-50: any person performing the work of any mechanic, laborer, or worker shall be paid prevailing wage

All Person who perform work ON SITE must be paid prevailing wage for the appropriate mechanic, laborer, or worker classification.

All certified payrolls must list the hours worked and wages paid to All Persons who perform work ON SITE regardless of their ownership i.e.: (Owners, Corporate Officers, LLC Members, Independent Contractors, et. al)

Reporting and payment of wages is required regardless of any contractual relationship alleged to exist between the contractor and such person.

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

Please direct any questions which you may have pertaining to classification of work and payment of prevailing wages to the Wage and Workplace Standards Division, telephone (860)263-6790.

As of: **Wednesday, December 05, 2018**

SECTION 20 00 50 - GENERAL CONDITIONS FOR MECHANICAL AND ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General provisions of the Contract, including General and Supplementary Conditions, General Requirements apply to the work specified in this Section.

B. Scope of Work: This Section contains special provisions for Divisions 23 and 26.

1.2 EXAMINATION OF SITE AND DRAWINGS:

A. Before submitting his bid, Contractor shall visit site with plans and specifications in hand, shall consult with the Engineer and shall become thoroughly familiar with all conditions under which his work will be done since he will be held responsible for any assumptions he may make in regard thereto.

B. The Contractor shall verify and obtain all necessary dimensions at the building.

C. Certain present building clearances are available for handling equipment.
All equipment shall be delivered knocked down as necessary to clear restrictions.

1.3 INTENT:

A. Finished Work: The intent of the specifications and drawings is to call for finished work, completed, tested and ready for operation.

B. Good Practice: It is not intended that the drawings show every pipe, fitting or minor detail and it is understood that while the drawings must be followed as closely as circumstances will permit, the systems shall be installed according to the intent and meaning of the Contract Documents and in accordance with good practice.

C. Work under each Section shall include giving written notice to the Owner within 15 days after the Award of the Contract of any materials of apparatus believed inadequate or unsuitable or in violation of any laws or codes, or items of work omitted. In the absence of such written notice, it is mutually agreed that work under each Section has included the cost of all required items and labor for the satisfactory functioning of the entire system without extra compensation.

D. Any apparatus, appliance, material or work not shown on drawings but mentioned in specifications or vice versa, or any incidental accessories necessary to make the work complete and perfect in all respects and ready for operation, even if not particularly specified, shall be furnished and installed by Contractor at no additional cost to Owner.

E. Prior to receipt of bids, Contractors shall give written notice to Engineer of any materials or apparatus believed inadequate, unsuitable or in violation of laws, ordinances, rules or regulations of authorities having jurisdiction and any necessary items or work omitted.

In the absence of such written notice, it is mutually agreed that Contractor has included the cost of all required items in his proposal and that he will be responsible for approved satisfactory functioning of systems without further compensation.

F. In all cases where apparatus is herein referred to in singular number, it is intended that such reference include as many such items as are required to complete work.

G. If not otherwise specified or shown on plans, apparatus and materials shall be installed in accordance with manufacturer's published recommendations and instructions and to the complete satisfaction of the Architect.

H. It is the intent of these specifications for Mechanical and Electrical Contractors and/or their subcontractors or equipment suppliers to furnish all equipment complete with all accessories.

1.4 REGULATIONS:

A. Codes: All work shall be done in strict accordance with the 2016 Connecticut State Building Code, 2016 Connecticut State Fire Safety Code, 2012 IBC, 2012 IPC, 2012 IMC, Connecticut Public Health Code, 2012 NFPA 101, all applicable NFPA Codes, NEC, UL, NEMA, O.S.H.A., with all requirements of local utility companies and the requirements of all governmental departments having jurisdiction.

B. Precedence: Requirements of the above shall take precedence over plans and specifications.

C. Equipment construction standards shall be as follows: Pressure vessels shall be constructed in accordance with the ASME Code, all electrical equipment shall be UL listed and approved and conform to the N.E.C., gas equipment shall be approved by A.G.A. and conform to N.F.P.A. Codes, piping materials, fittings, valves and accessories shall be constructed in accordance with A.S.T.M. and A.N.S.I. standards for class of work involved. All equipment and materials shall be new and of domestic manufacture. All the above codes shall be referenced and dated in the Connecticut Basic Building Code.

D. Wherever discrepancies occur between above regulations and agencies and contract drawings and specifications, the requirements of above shall take precedence, except that the contract drawings and specifications shall be minimum requirements and that contractors shall advise engineer of any required changes before proceeding with work.

1.5 APPROVED FITTINGS:

A. No material other than that contained in the "Latest List of Electric Fittings" approved by the Underwriters' Laboratories, Inc., shall be used in any part of the work. All wiring, conduit, switches and other material for which label service has been established, shall bear the label of the Underwriters' Laboratories, Inc.

1.6 PERMITS, FEES:

A. Include all necessary notices, obtain all permits and pay all governmental taxes, fees, and other costs. File all necessary plans, prepare all documents and obtain all necessary approvals of all governmental departments having jurisdiction. Obtain all required Certificates of the Owner before request for acceptance and final payment for the work.

1.7 DEFINITIONS:

A. Words "finish" or "finished" refer to all rooms and areas listed in Finished Schedule on Architect's Drawings. All rooms and areas not covered in Schedule, including underground tunnels and areas above ceilings, shall be considered not finished except as otherwise noted.

B. The word "provide" means to "furnish and install" reference item.

1.8 PROTECTION:

A. Work under each section shall include protecting the work and materials of all other sections from damage by work or workmen, and shall include making good any and all damage thus caused.

B. Each section shall be responsible for work and equipment until finally inspected, tested and accepted. Protect work against theft, weather, injury or damage and carefully store material and equipment received on site which is not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing materials.

C. If so specified under the respective section, work may include receiving, unloading, uncrating, storing, protecting, setting in place and connecting up completely of any motor starters, control equipment having mechanical/electrical service connections which may be furnished by Owner or furnished under another section.

Work under each section shall include exercising special care in handling and protecting equipment and fixtures. Any of the above equipment and fixtures which are missing or damaged by reason of mishandling or failure to protect shall be replaced at no additional cost to the Owner.

1.9 EQUIPMENT SUBSTITUTIONS AND DEVIATIONS:

A. Wherever more than one manufacturer is mentioned in specifications and drawings, any of these named are considered equally acceptable to that on upon which design was based and, providing all requirements are met, insofar as performance, space requirements, noise levels and special accessories or materials are concerned, any of those named may be included in Contractor's bid.

B. Where Contractor proposes to use an item of equipment which differs from that upon which design was based, which required any redesign of structure, partitions, foundations, piping, wiring or of any other part of Mechanical, Electrical or Architectural Layout, all such redesign, new drawings or detailing required shall be prepared by Contractor at his own expense for approval of Engineer.

C. Where approved substitutions or deviations require a different quantity, size or arrange of structural supports, wiring, conduit, piping, ductwork, and equipment from that upon which design was based, all additional items required by the systems shall, with the approval of Engineer, be furnished by Contractor at no additional cost to Owner.

1.10 ELECTRICAL WORK:

A. The Electrical Section includes all power wiring for all electrical switches, motor starters and unmounted motors, furnished at the job site by other sections or furnished under the Electrical Sections as stated in other sections of the specifications.

B. The Electrical Section shall install and wire all starters, switches and controls, as specified and/or shown on drawings. This shall include all operating and safety controls.

C. Electrically operated equipment supplied by other sections which will be installed and wired by Electrical Section shall be delivered to him with detailed instructions for their installation and wiring in sufficient time and proper sequence to enable him to meet his work schedule.

D. Control devices that include mechanical elements, such as float switches, shall be installed by the section furnishing them, but be wired by the Electrical Sections.

E. Equipment which includes a number of correlated electrical control devices mounted in a single enclosure or on a common base with equipment shall be supplied for installation completely wired as unit with terminal boxes and ample leads and/or terminal strips, ready for electrical wiring.

F. Electrical Contractor shall furnish local disconnect switch for all equipment and manual motor starter for fractional HP motors.

1.11 DRAWINGS:

A. The mechanical and electrical drawings are intended to supplement each other and are to be considered as a unit which, taken together in conjunction with the specifications, completely describes the work to be done. All drawings shall be checked to verify spaces in which work will be installed. Where headroom or space conditions appear inadequate, notification shall be given to Engineer before proceeding with installation.

B. The Engineer may without charge, make modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.

C. Note that the drawings are diagrammatic and indicate the general arrangement of the Mechanical and Electrical Equipment and systems, without showing every detail and fitting.

D. Where conflicts occur between drawings and specifications or within either, the item or arrangement of better quality, greater quality or highest cost shall be included in Contract price. Engineer shall determine the manner or item with which work shall be installed.

E. Keep one complete set of all drawings, specifications, shop drawings and addenda on the premises at all times in good condition and available to the Engineer and Owner.

1.12 REVIEWS:

A. The materials, workmanship, design and arrangement of all work installed under the Mechanical and Electrical sections shall be subject to the review of the Engineer.

B. Where any specific material process of method of construction or manufactured article is specified by name or by reference to the catalog number of a manufacturer, the specifications are to be used as a guide and not intended to take precedence over the basic duty and performance specified or noted on drawings. In all cases, the specific characteristics of the equipment offered for approval, shall be indicated on the shop drawings.

C. All component parts of each item of equipment or device shall bear the manufacturer's nameplate, giving name of manufacturer, description, size, type, serial or model number, electrical characteristics, etc. in order to facilitate maintenance or replacement. The nameplate of a subcontractor or distributor will not be acceptable.

D. If material or equipment is installed before it is reviewed, it shall be removed and replaced at no extra charge to the Owner if, in the opinion of the Engineer, the material or equipment does not meet the intent of the drawings and specifications.

1.13 SHOP DRAWINGS:

A. Contractor shall submit for review electronic shop drawings of all new equipment, materials, piping, lighting fixtures, devices, panels, wiring and reports. Engineer's review of shop drawings must be completed before any equipment is purchased or any work is installed.

B. Shop drawings shall consist of manufacturer's certified scale drawings, cuts or catalog, including descriptive literature and complete certified characteristics of equipment, showing dimensions, capacity, code requirements, motor and drive testing as indicated on the drawings or specifications. Also, sheet metal fabrication drawings drawn to scale of 1/4" to the foot or larger.

C. Certified performance curves for all pumping equipment shall be submitted for review.

D. Samples, drawings, specifications, catalogs, etc. submitted for review shall be properly labeled indicating specific service for which material or equipment is to be used, division and article number of specifications governing Contractor's name and name of job.

E. Catalog, pamphlets or other documents submitted to describe items on which review is being requested, shall be specific and identification in catalog, pamphlet, etc. of item submitted shall be clearly made in ink. Data of a general nature will not be accepted.

F. Review stamp rendered on shop drawings shall not be considered as a guarantee of measurements of building conditions. Where drawings are reviewed, said review does not mean that drawings have been checked in detail. Said review does not in any way relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by the Contract Drawings and Specifications.

G. Failure by the Contractor to submit shop drawings in ample time for checking shall not entitle him to an extension of Contract and no claim for extension by reason of such default will be allowed.

H. Prior to submission of shop drawings, the Contractor shall thoroughly check each shop drawing, reject those not conforming to the specifications and indicate by his signature that the shop drawings submitted in his opinion meet Contract requirements.

1.14 CUTTING AND PATCHING:

A. Cutting and patching shall be done in accordance with Division 01, section 017329 unless otherwise specified.

B. The General Contractor will leave all openings and built-in sleeves, etc. as required, provided he receive same with the proper information and cooperation from the Electrical and/or Mechanical Contractor in due time as the construction progresses.
All cutting of openings in walls, floors, partitions, etc. not thus provided for must, however, be done by the Electrical and/or Mechanical Contractor as required to install the work including all cutting of existing construction work, and this Contractor shall restore to its original condition any work disturbed.

PART 2 - PRODUCTS

2.1 MATERIALS AND WORKMANSHIP:

A. All materials and apparatus used shall be new, of first class quality and shall be furnished, delivered, erected, connected and finished in every detail. No materials or apparatus used shall be discontinued or about to be discontinued items.

B. The Engineer shall have the right to reject any part of the work in case material or workmanship is not of satisfactory quality.

C. Any unacceptable work and material shall be replaced with acceptable work and material at no additional expense to the Owner.

D. In case there is any doubt of the acceptability of any material, submit samples to the Engineer for approval and only definite approval in writing from the Engineer shall be evidence of such approval. Such approval shall also be subject to the satisfactory installation of the material.

E. The work in each of these sections shall be constantly under the direction of a competent superintendent who shall be on the premises during such period as the work is in progress. The superintendent shall familiarize himself with the work of all other sections involved insofar as they relate to or in any way affect the work of these sections, and shall coordinate the work.

F. Unless otherwise noted, all equipment and materials shall be installed and/or applied in accordance with the recommendations of the manufacturer of said equipment, including the performance of any tests recommended by the manufacturer.

2.2 EQUIPMENT VARIATIONS:

A. In these specifications and on the accompanying drawings, one or more makes of materials, apparatus or appliances have been specified for use in this installation. This has been done for convenience in fixing the standard of workmanship performance of any materials, apparatus or appliance which shall be substituted for those mentioned herein shall also conform to these standards.

B. Where no specified make or material, apparatus or appliance is mentioned, any first class product made by a reputable manufacturer may be used, providing it conforms to the requirements of these specifications and meets the approval of the Engineer.

C. Refer to General Conditions of the contract for substitution procedures.

D. To substitute other makes of materials, apparatus or appliance, than those mentioned under the mechanical or electrical sections, a request in writing to be allowed to make the substitution shall be made. This request shall be accompanied by complete plans and specifications of the substitution offered. If so requested by the Architect or Engineer, also submit samples of both the specified material or appliance and the substitute.

2.3 ACCESS DOORS:

A. Access doors shall be of sufficient size to permit easy replacement of complete units and all groupings of complete units and all groupings of valves and equipment shall have necessary clearance for this same purpose. Provide access doors for each valve, damper, control, fire damper, etc., not accessible (such as above a non-lift out ceiling, wall or chase). Doors shall be Milcor or equal prime coated steel, screwdriver lock for building into walls or ceilings. Doors shall be Style A in acoustic tile surfaces and Styles K, L or M for other surfaces. Doors shall bear the same or greater fire rating as the wall or ceiling in which they occur. Size of doors to be determined after valves or dampers are installed and shall be of adequate size to operate same.

B. Where access is required to dampers, valves, etc., that occur above lay-in ceilings, these access doors can be omitted, provided suitable plastic markers identifying exact location of valves, dampers, etc., on lay-in ceilings are applied directly below valve grouping and identified by a number, this number to be used as a marking on valve or damper chart. Tags shall be applied on the ceiling grid, not on the ceiling tiles.

PART 3 - EXECUTION

3.1 CONNECTING TO EXISTING UTILITIES:

A. Connections to existing utilities that will interrupt the service to the present buildings shall be made at a time agreed upon by the Owner, Architect and Contractor.

B. If it is necessary to make connections to existing utilities outside the regular working hours, this shall be noted on the written work order and the respective Contractor will be paid for the additional cost of labor over and above what it would cost at regular day time rates.

3.2 FREIGHT, CARTING AND RIGGING:

A. Contractor shall pay all freight and carting charges necessary to deliver all equipment furnished under his Contract to the site and furnish all necessary rigging to properly rig and set the apparatus on the foundations, frames, etc.

B. All scaffolding, blocks and tackle, ropes and chains and other equipment necessary to rig and set the apparatus shall be furnished by the Contractor.

C. The Contractor shall set, level and align all equipment before starting operations.

3.3 SEISMIC RESTRAINTS:

A. It is the intent of this seismic restraint portion of the specification to provide restraint of all non-structural building system components provided in Sections 15 and 16 in Seismic Zone II. Restraint systems and devices are intended to withstand, without failure, the "G" forces detailed in the chart below:

Design Level of Acceleration At Equipment Center of Gravity Seismic Zone 2)
(Av - >0.1 to 0.19)

Elevation (feet rel. to grade level)	Rigid* Mnt'd Equip	Non-Struct. Architect Component	Flexible* Mnt'd Equip	Pipe, Duct, Cable trays, Conduit, Etc.	Life Safe. Equip
Below Grade up to 20 feet above grade	0.125 "g"	0.250 "g"	0.500 "g"	0.350 "g"	1.000 "g"
21 ft. - 300 ft.	0.500 "g"	0.550 "g"	0.750 "g"	0.650 "g"	1.000 "g"
301 ft. - 600 ft.	0.750 "g"	0.900 "g"	1.000 "g"	1.000 "g"	1.000 "g"

* Rigid mounted equipment is any equipment mounted directly to structure. Flexible mounted equipment is any equipment mounted on resilient supports, ceiling suspended, roof supported or mounted on an independent frame with any primary natural frequency below 16 Hz.

B. Seismic restraints shall be as required by the 2016 Connecticut Building Code.

C. Refer to section 220548 and drawings for details.

D. Seismic Certification and Analysis

1. Seismic restraint calculations must be provided for all connections of equipment to the structure.
2. Calculations to support seismic restraint designs must be stamped by a registered professional engineer licensed in the State of Connecticut.
3. Analysis must indicate dead loads, derived loads, and materials used for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameters, embedment, and weld length.
4. A seismic design errors and omissions insurance certificate must accompany submittals.

E. Submit drawings showing locations of all seismic restraints for equipment, piping, and conduit provided under Sections 21, 22, 23, 26, 27 and 28.

1. The term EQUIPMENT includes ALL non-structural components. These specifications are applicable within the facility and 5 feet outside of the foundation wall. Equipment buried underground is excluded but entry of services through the foundation wall is included.

Equipment referred to below is a partial list; (equipment not listed is still included in this specification).

AC Units	Condensing Unit
Conduit	All Electrical Panels

F. Submittals shall include a listing of all isolated and non-isolated equipment to be restrained.

G. Seismic restraints shall not be required for the following installations:

1. Piping in mechanical rooms less than l 1/4-inch inside diameter.
2. All other piping less than 2 1/2-inch inside diameter.
3. All electrical conduit less than 2 1/2-inch inside diameter.
4. All rectangular air-handling ducts less than 6 square feet in cross-sectional area.
5. All round air-handling ducts less than 28 inches in diameter.
6. All piping suspended by individual hangers 12 inches or less in length from the top of the pipe to the bottom of the support for the hanger.
7. All ducts suspended by hangers 12 inches or less in length from the top of the duct to the bottom of the support for the hanger.

H. Life safety systems defined:

1. All systems involved with fire protection including sprinkler piping, service water supply piping, fire dampers and smoke exhaust systems.
2. All systems involved with and/or connected to emergency power supply including all generators, transfer switches, transformers and all flow paths to fire protection and/or emergency lighting systems.
3. Fresh air relief systems on emergency control sequence including air handlers, conduit, duct, dampers, etc.

3.4 COOPERATION WITH OTHER TRADES:

A. No piping, ducts, conduit, valves, boxes, etc., shall be installed until the entire run has been checked for clearance and the work has been coordinated between all the trades. Each tradesman shall be responsible for taking his own field measurements and maintaining proper clearance from the Owner's equipment and the work of other trades, and for coordinating his work with that of other Contractors and Owner. Furnish all necessary information, dimensions, templates, etc. in order that a perfectly coordinated job will result.

B. Contractor shall carry out his work in conjunction with other trades and shall give full cooperation to other trades. Contractor shall furnish all information necessary to permit work of all trades to be installed in a satisfactory manner.

C. Where space is so limited that Contractor's work shall be installed in close proximity to the work of other trades or where it is evident that Contractor's work will interfere with other trades, he shall assist in working out space conditions to make satisfactory adjustments. If required or directed by Engineer, the Contractor shall prepare composite working drawings and sections of not less than 3/4" -1'-0" scale clearly showing how his work is to be installed in conjunction with other trades; he shall make corrections necessary to satisfactorily complete installation at no additional cost to Owner.

D. All supports for hanging material to be connected to steel structure shall be installed prior to installation of fire proofing material. Refer to Division 7 of the specifications.
Any damage to fireproofing caused by late installation of hanging material shall be repaired by the Fire-proofing Contractor at the expense of the Contractor responsible.

E. The Plumbing and Heating Contractors shall give to the Electrical Contractor all information on switches, controls, pilots, etc. furnished under the Plumbing and Heating Contracts, together with makes and catalog numbers where required to permit the Electrical Contractor to leave the proper boxes to receive same. This information shall be given well in advance so that the Electrical Contractor may install his work as construction progresses. In the event that this information is not given in time to permit the Electrical Contractor to leave proper boxes, etc. as construction progresses, it shall be the responsibility of the Contractor to pay all costs of cutting and patching construction required because of this neglect.

3.5 INFORMATION FOR ELECTRICAL CONTRACTOR:

A. Deliver to the Electrical Contractor all information on motors and controls furnished under the Mechanical Contract, together with makes and catalog numbers, to permit the Electrical Contractor to leave the proper boxes and wiring.

B. Each electric motor of 1/2 h.p. or more shall be furnished with an automatic starter.

C. Starters shall be furnished in type to be remotely controlled and fed from dual voltage transformer 208/460 120 volts.

D. Starters to have overload and undervoltage protection. Starters shall be of the combination disconnect switch and starter type.

3.6 SLEEVES, INSERTS AND ANCHOR BOLTS:

A. All pipes and conduits passing through floors, walls or partitions shall be provided with sleeves sized to give a minimum of 1/2" clearance between sleeve and the outside diameter of the pipe, conduit or insulation, enclosing the pipe or conduit.

B. Sleeves through concrete floors or interior masonry walls shall be Schedule 40 steel pipe, set flush with finished wall or ceiling surfaces, but extending 2 inches above finished floors or shall be in accordance with details on drawings.

In all mechanical equipment rooms or penthouses, sleeves shall extend 6 inches above finished floor.

C. Inserts shall be individual or strip type of steel or malleable iron construction for removable nuts and threaded rods up to 3/4" diameter, permitting lateral adjustment.

D. Provide escutcheons on all pipes and conduits wherever they pass through floors, ceilings, walls, or partitions in finished areas. Escutcheons for pipes passing through floors shall be RITTER PATTERN AND CASTING COMPANY, No. 36A or approved equal split-hinged, cast brass type designated to fit pipe on one end and cover alcove projecting through floor on the other end.

Escutcheons for pipes shall be RITTER PATTERN AND CASTING COMPANY, No. 3A or approved equal - split-hinged, cast brass, chromium plated type.

3.7 FIRE STOPPING:

A. General

1. Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.

B. General Description of the Work : Only tested firestop systems shall be used in specific locations as follows: Penetrations for the passage of duct, cable, cable tray, conduit, piping, electrical busways and raceways through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.

C. References

1. Test Requirements: ASTM E-814, "Standard Method of Fire Tests of Through Penetration Fire Stops" (July 1997).

2. Underwriters Laboratories (UL) of Northbrook, IL runs ASTM E-814 under their designation of UL 1479 and publishes the results in their "FIRE RESISTANCE DIRECTORY" that is updated annually.

3. International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments

4. Test Requirements: ASTM E 84-96, "Surface burning characteristics".

5. All major building codes: ICBO, SBCCI, BOCA, and IBC.

6. Test Requirements: ASTM E-119, “Fire Test of Building Construction and Materials” (UL 263)

D. Quality Assurance

1. Firestop System installation must meet requirements of ASTM E-119, ASTM E-814, ASTM E-84-96, UL 236, UL 1479 or UL 2079 tested assemblies that provide a fire rating equal to that of construction being penetrated.

2. Firestop Systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.

E. Submittals

1. Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of UL firestop systems to be used and manufacturer's installation instructions to comply with Section 013300.

2. Submit material safety data sheets provided with product delivered to job-site.

F. Installer Qualifications

1. Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacture's products per specified requirements.

G. Products, General

1. Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.

2. Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

3. Firestopping Materials are either "cast-in-place" (integral with concrete placement) or "post installed." Provide cast-in-place firestop devices prior to concrete placement.

H. Acceptable Manufacturers

1. Subject to compliance with through penetration firestop systems (XHEZ) and joint systems (XHBN) listed in Volume II of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:

a. Hilti, Inc., Tulsa, Oklahoma 800-879-8000
b. Other manufacturers listed in the U.L. Fire Resistance Directory – Volume 2

I. Materials

1. Use only firestop products that have been UL 1479, ASTM E-814, or UL 2079 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.

2. Provide a firestop system with a "F" Rating as determined by UL 1479 or ASTM E814 which is equal to the time rating of construction being penetrated.

3. Provide a firestop system with an Assembly Rating as determined by UL 2079 which is equal to the time rating of construction being penetrated.

J. Preparation

1. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

a. Verify penetrations are properly sized and in suitable condition for application of materials.

b. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
c. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
d. Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
e. Do not proceed until unsatisfactory conditions have been corrected.

K Coordination

1. Coordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for the work. Ensure device is installed before placement of concrete.

2. Responsible trade to provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interferences.

L. Installation

1. Regulatory Requirements: Install firestop materials in accordance with UL Fire Resistance Directory.

2. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration and construction joint materials.

a. Seal all holes or voids made by penetrations to ensure an air and water resistant seal.
b. Consult with project manager, and damper manufacturer prior to installation of UL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
c. Protect materials from damage on surfaces subjected to traffic.

M. Field Quality Control

1. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
2. Keep areas of work accessible until inspection by applicable code authorities.
3. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

N. Adjusting and Cleaning

1. Remove equipment, materials and debris, leaving area in undamaged, clean condition.
2. Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

3.8 ACCESSIBILITY:

A. Locate all equipment which must be serviced, operated or maintained in fully accessible positions. Equipment shall include but not be limited to motors, controllers, switchgear, drain points, etc. If

required for better accessibility, furnish access doors for this purpose. Access doors shall be selected by the Architect/Engineer to specific area finishes. Minor deviations from drawings may be made to allow for better accessibility, only if approved by the Engineer. Provide fire rated access doors in rated walls, access doors shall be provided in Milcor or equal.

B. In the event that any equipment is not installed to permit convenient servicing, disassemble, removal of parts, etc. the Contractor shall, at his own expense, make all corrections necessary to accomplish this.

3.9 TAGS, CHARTS AND NAMEPLATES:

A. Each piece of apparatus installed under these sections shall be properly identified.

B. All equipment shall be provided with a suitable laminated plastic nameplate fastened with screws or rivets. Small equipment labels may use a pressure sensitive tape.

C. All nameplates and labels shall identify components by proper nomenclature and numbered according to equipment schedule or as designated.

3.10 INSTRUCTIONS:

A. Prepare written instructions frames for the proper maintenance and operation of any special equipment furnished and installed under this Contract.

B. Personally instruct the Owner's Custodian or official representative in addition to furnishing all manuals, diagrams, etc. in the proper operation and maintenance of all equipment and piping installed under this Contract.

C. Prepare a portfolio with all tags, operating manuals, parts lists, guarantees, etc. that are packed with all equipment furnished under this Contract and submit same to the Architect.

3.11 **EQUIPMENT NOT IN CONTACT AND PREPURCHASED BY OWNER:**

A. The Owner has purchased mechanical equipment listed elsewhere. This Contractor shall be given the purchase order and shall at that time assume full responsibility for delivery, installation and guarantee of said equipment as if he has purchased the equipment.

B. Furnish all piping, wiring, sheet metal connections and miscellaneous accessories, and make all closing connections to equipment furnished by Owner; include installation of all special traps, control valves and supplies furnished with such equipment. Refer to section in which outlines equipment requirements and all other specifications sections as may be pertinent to comply with intent of this Article.

C. Unless otherwise detailed on drawings, roughing of proper size and capacity for equipment indicated on Mechanical or Electrical drawings as "Future" or "NIC" shall be provided and installed in such a manner and location that future final connection can be made with a minimum of work and without cutting or patching walls, partitions, ceilings or floors.

D. Engineers' drawings are, of necessity, schematic for special equipment as exact roughing and requirements may vary with different manufacturers.

E. Contractor shall obtain approved shop drawings of equipment being furnished for extent of final connections and exact roughing required.

3.12 CLEANING PIPING, CONDUITS AND EQUIPMENT:

A. Thoroughly clean all piping and equipment of all foreign substances inside and out before being placed in operation.

B. If any part of a system should be stopped by any foreign matter after being placed in operation, the system shall be disconnected, cleaned and reconnected wherever necessary to locate and remove obstructions. Any work damaged in the course of removing obstructions shall be repaired or replaced when the system is reconnected at no additional cost to the Owner.

C. During the course of construction, all pipe and electrical conduits shall be capped in an approved manner to insure adequate protection against the entrance of foreign matter.

3.13 CLEANING UP:

A. After completion of the work, remove all waste, rubbish and other materials left as a result of operations and leave the premises in clean condition.

B. All fixtures, equipment, etc. installed under the Mechanical and Electrical Sections shall be free of dirt, grease and other foreign material and left in perfectly clean condition and ready to use.

3.14 GUARANTEE:

A. All parts of the work and all equipment shall be guaranteed for a period of at least 18 months from the date of acceptance of the job by the Owner.

B. If during that period of general guarantee, any part of the work installed fails, becomes unsatisfactory or does not function properly due to any fault in material or workmanship, whether or not manufactured or job built, each section shall upon notice from the Owner, promptly proceed to repair or replace such faulty material or workmanship without expense to the Owner, including cutting, patching and painting or any other work involved and including repair or restoration of any damaged sections of the premises resulting from such faults.

C. In the event, that a repetition of any one defect occurs, indicating the probability of further failure, and which can be traced to faulty design, material or workmanship, then repairs or replacement shall not continue to be made but, the fault shall be remedied by a complete replacement of the entire defective unit.

D. In addition to the general guarantee, obtain and transmit to the Owner any guarantees or warranties from manufacturers of specialties but only as a supplement to the general guarantee which will not be invalidated by same.

3.19 OWNER'S INSTRUCTIONS AND SYSTEM OPERATION:

A. At the time of the job's acceptance by the Owner, Contractor shall furnish one complete set of reproducible approved, certified drawings to the Owner. In addition, Contractor shall furnish maintenance and operating instructions for all equipment including parts list.
These instructions shall be written in layman's language and shall be inserted in vinyl covered three-ring loose leaf binder. This information in binder shall be first sent to the approved by the Architect/Engineer before turning over to the Owner.

B. Upon completion of all work and of all tests, each Division shall furnish the necessary skilled labor and helpers for operating the system and equipment for a period of one (1) day of eight (8) hours, or as otherwise specified. During this period, instruct the Owner or his representative fully in operation, adjustment and maintenance of all equipment furnished. Give at least forty-eight (48) hours notice to the Owner in advance of this period.

3.20 OWNER'S ACCEPTANCE TEST:

A. After the various systems are complete as determined by preliminary operating tests, the Contractor shall arrange for the Owner's final acceptance tests.

B. The Contractor shall have present at each acceptance test, representatives of the several Contractors whose work is directly or indirectly involved, with instruments as necessary in accordance with the design and to include the following.

1. All equipment installed and operating in accordance with manufacturer's instructions and performance guarantee.
2. All systems operating in accordance with specifications.
3. All distribution systems properly adjusted for distribution to equipment as specified.
4. All `as built` drawings, valve charts, etc. as specified in various parts of the specifications installed or ready for delivery to the Owner.

C. The date of the Owner's acceptance of the equipment shall be the start of the 18 months guarantee period.

3.21 TEST:

A. Conducting Tests: Conduct all tests called for under the various sections or as required and repair or replace any defects. Perform all tests in the presence of and to the satisfaction of the Engineer and such other parties as may have legal jurisdiction.

B. Defective Work: The Owner shall have the privilege of stopping any of the work not being properly installed. All such defective work shall be repaired or replaced and the tests shall be repeated.

C. Repair Damaged Work: Repair all damages resulting from tests and replace damaged materials.

END OF SECTION 20 00 50

SECTION 23 05 48 -VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING & EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General Provisions of the Contract, including General and Supplementary Conditions and Division 1, General Requirements, apply to the work specified in this Section.

B. The General Requirements in Section 200050 shall also govern the work under this Section.

1.2 SECTION INCLUDES:

A. Vibration isolation and seismic restraints for all mechanical and electrical system including equipment, piping, conduit and ductwork within the building.

B. The work of this section includes but is not limited to the following:

1. Vibration isolation elements.
2. Equipment isolation bases.
3. Piping flexible connections.
4. Seismic restraints for isolated and non-isolated mechanical and electrical items.

1.3 REFERENCES:

A. State of Connecticut Building Code.

B. SMACNA - Seismic Restraint Manual Guidelines for Mechanical Systems.

C. Mason Industries, Inc. Seismic Restraint Guidelines

1.4 QUALIFICATIONS:

A. Qualifications: Only firms having five years experience designing and manufacturing seismic devices shall be capable of work in this specification.

1.5 SUBMITTALS:

A. Submit under provisions of Section 200050.

B. The submittal material shall include copies of descriptive data for all products and materials including but not limited to the following:

1. Descriptive Data:

a. Catalog cuts and data sheets.
b. An itemized list showing the items to be isolated and/or seismically restrained, product type or model number to be used and loading and deflection data.
c. Seismic restraint calculations.

d. (Structural or civil engineer's State of Connecticut professional engineer's seal verifying design and calculations for seismic restraining system used.)

2. Shop Drawings:

a. Drawings showing equipment base construction for each machine, including dimensions, structural member sizes, and support point locations.
b. Drawings showing methods of suspension, support guides for conduit, piping and ductwork.
c. Drawings showing methods for isolation of conduits, pipes and ductwork penetrating walls and floor slabs.
d. Concrete and steel details for bases including anchor bolt locations.
e. Number location of seismic restraints and anchors for each piece of equipment.
f. Specific details of restraints including anchor bolts for mounting and maximum loading at each location, for each piece of equipment and/or pipe and duct locations.

1.6 GENERAL (MANUFACTURER) RESPONSIBILITIES:

A. Contractor shall have the following responsibilities:

1. Determine vibration isolation and seismic restraint sizes and locations per specifications.
2. Provide and install isolation systems and seismic restraints as scheduled or specified.
3. Guarantee specified isolation system deflection.
4. Provide installation instructions, drawings and field supervision to assure proper installation and performance.
5. Substitution of "Internally Isolated" mechanical equipment in lieu of the specified isolation of this section may be acceptable provided that all specified deflections and stamped seismic calculations are supplied by the equipment manufacturer.

1.7 PROJECT RECORD DOCUMENTS:

A. Submit under provisions of Section 200050.

B. Record actual locations and installation of vibration isolators and seismic restraints including attachment points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Mason Industries Inc. models listed below.

B. Other approved manufacturers providing equivalent products include:

1. Vibration Eliminator Co.
2. Amber/Booth Co.

2.2 SEISMIC RESTRAINT TYPES:

A. General: Installations shall be designed to safely accept external forces of one-half "G" load in any direction for all rigidly supported equipment without failure and permanent displacement of the equipment. Life safety equipment such as (fire pumps, sprinkler piping and emergency generators) shall be capable of safely accepting external forces up to one "G" load in any direction without permanent displacement of the supported equipment. Seismic restraints shall not short circuit vibration isolation systems or transmit objectionable vibration or noise.

B. Type I (spring mount): Shall comply with general characteristics of spring isolators having a minimum o.d. to o.h. of .8 to 1 and minimum runout of 50% to solid. Shall incorporate snubbing restraint in all directions. Shall be capable of supporting equipment at a fixed elevation during equipment erection. Cast housings shall be ductile iron or aluminum. System to be field bolted or welded to deck with I G acceleration capability. Mason Type SSLFH or as approved.

C. Type II (snubber): Each corner of side shall incorporate a seismic restraint having a minimum 5/8" thick resilient pad limit stops working in all directions. Restraints shall be made of plate, structural members, or square metal tubing concentric within a welded assembly incorporated resilient pads. Angle bumpers are not acceptable. System to be field bolted or welded to a deck with 1 G acceleration capability. Mason Type Z-1011 and Z-1225.

D. Type III (cable braces): Metal cable type with approved end fastening devices to equipment and structure.

System to be field bolted to deck or overhead structural members using two sided beam clamps to steel or appropriately designed insert for concrete. All parts of system including cables, clamps, excluding fastenings are to be single vendor furnished to assure seismic compliance. Mason Type SCB.

E. Type IV (neoprene mount): Double deflection neoprene isolator encased in ductile iron or steel casing minimum .30 static deflection. System to be field bolted or welded to deck with 1 G acceleration capacity. Mason Type BR, RBA.

F. Type V: Non-isolated equipment to be field bolted or welded (powder shots not acceptable) to resist seismic forces unless under 100 lb. Shear force required. Mason Type SAS, SAB.

2.3 VIBRATION ISOLATION – GENERAL:

A. Vibration Isolation shall control excessive noise and vibration in the building due to the operation of machinery or equipment, and/or due to interconnected piping, ductwork, or conduit. (The installation of all vibration isolation units, and associated hangers and bases, shall be under the direct supervision of the vibration isolation manufacturer's representative.)

B. All vibration isolators shall have either known non-deflected heights or calibration markings so that, after adjustment, when carrying their load, the deflection can be verified.

C. All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer and must be linear over a deflection range of not less than 50% above the design deflection.

D. The theoretical vertical natural frequency for each support point, bases upon load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as a whole by more than +/- 10%.

E. All neoprene mountings shall have a Shore hardness of 30 to 60 +/- 5, after minimum aging of 20 days or corresponding oven aging.

2.4 VIBRATION ISOLATOR TYPES:

A. Type A: Spring isolators:

1. Minimum diameter of 0.8 of the loaded operating height.
2. Corrosion resistance where exposed to corrosive environment with:

    a. Springs cadmium plated or electro-galvanized.
    b. Hardware cadmium plated.
    c. All other metal parts hot-dip galvanized.

3. Reserve deflection (from loaded to solid height) of 50% of rated deflection.
4. Minimum ¼" thick neoprene acoustical base pad on underside, unless designated otherwise.
5. Designed and installed so that ends of springs remain parallel and all springs installed with adjustment bolts.
6. Non-resonant with equipment forcing frequencies or support structure natural frequencies.
7. Mason Type SLF.
8. When used in conjunction with seismic bracing, seismic restraint Type II shall be installed.

B. Type B: Spring isolators shall be same as Type A, except:

1. Provide built-in vertical limit stops with minimum ¼" clearance under normal operation.
2. Tapped holes in top plate for bolting to equipment when subject to wind load.
3. Capable of supporting equipment at a fixed elevation during equipment erection. Installed and operating heights shall be identical.
4. Adjustable and removable spring pack with separate neoprene pad isolation.
5. Capable of accepting 1 G of acceleration.
6. Mason Type SLR.

C. Type C: Spring hanger rod isolators:

1. Spring element seated on a steel washer within a neoprene cup incorporating a rod isolation bushing.
2. Steel retainer box encasing the spring and neoprene cut.
3. When used in conjunction with seismic bracing, seismic restraint Type III shall be installed.
4. Mason Type HS.

D. Type D: Seismic Restraint, Type IV: Double deflection neoprene isolator encased in ductile iron or steel casing minimum .30 static deflection. System to be field bolted or welded to deck with 1 G acceleration capacity. Mason Type BR, RBA.

E. Type E: Elastomer hanger rod isolators:

1. Molded unit type neoprene element with projecting bushing lining rod clearance hole.
2. Neoprene element to be minimum 1-3/4" thick.
3. Steel retainer box encasing neoprene mounting.
4. Clearance between mounting hanger rod and neoprene bushing shall be minimum of 1/8".
5. Minimum static deflection of 0.35".
6. When used in conjunction with seismic bracing, seismic restraint Type III shall be installed.
7. Mason Type HD.

F. Type F: Combination spring/elastomer hanger rod isolators:

1. Spring and neoprene isolator elements in a steel box retainer. Neoprene double deflection type. Single deflection is unacceptable. Spring seated in a neoprene cup with extended rod bushing.
2. Characteristics of spring and neoprene as described in Type A and Type E isolators.
3. When used in conjunction with seismic bracing, seismic restraint Type III shall be installed.
4. Mason Type DNHS.

G. Type G: Pad type elastomer mountings:

1. ¾" Minimum thickness.
2. 50 PSI maximum loading.
3. Waffled design.
4. Deflection per pad thickness.
5. Galvanized steel plate between multiple layers or pad thickness.
6. Suitable bearing plate to distribute load.
7. Mason Type Super W.

H. Type H: Grommet type elastomer bushings:

1. One piece molded bridge bearing neoprene.
2. Washer / bushing shall surround the anchor bolt.
3. Flat washer face to avoid metal to metal contact.
4. Mason Type HG.

I. Type K: Pipe Anchors: All-directional acoustical pipe anchor consisting of a telescopic arrangement of two sizes of steel tubing separated by a minimum one-half inch thickness of heavy-duty neoprene and duck or neoprene isolation material. Vertical restraints shall be provided by similar material arranged to prevent vertical travel in either direction. Allowable loads on the isolation material travel in either direction. Allowable loads on the isolation

material shall not exceed 500 psi and the design shall be balanced for equal resistance in any direction. Isolation to be bolted or welded depending on structure. Mason Type ADA.

2.5 EQUIPMENT BASES:

A. Integral Structural Steel Base, Type B-1:

1. Reinforced as required to prevent base flexure at start-up and misalignment of drive and driven units. Centrifugal fan bases complete with motor slide rails.
2. Drills for drive and driven unit mounting template.
3. Must be utilized with seismic restraint Type I, II, or IV.
4. Mason Type M, WFB.

B. Concrete Inertia Base, Type B-2:

1. Vibration isolator manufacturer shall furnish rectangular structural concrete forms for floating foundation. Bases for split case pumps shall be large enough to provide support for suction and discharge base ells. The base depth shall be a minimum of 1/10 of the longest span but not less than 6" or greater than 14".Forms shall include minimum concrete reinforcement consisting of ½" bars or angles in place in 6" centers running ways and a layer 1 ½" above the bottom and a top layer of reinforcing steel as above for all bases exceeding 120" in one direction. Isolators shall be set into pocket housings which are an integral part of the base construction and set at the proper height to maintain a 1" clearance below the base. Bases shall be furnished with templates and anchor bolt sleeves as part of this system.

2. Must be utilized with seismic restraint Type I, II or IV.

3. Mason Type K, BMK.

2.6 FLEXIBLE CONNECTORS:

A. Elastomer Type FC-1:

1. Manufactured of Kevlar reinforcement and EPDM, both molded and cured with hydraulic presses.
2. Straight connectors to have two spheres reinforced with a molded-in external ductile iron ring between spheres.
3. Elbows shall be long radius type.
4. Rated 250 psi at 170 degrees F. Dropping in a straight line to 170 psi at 250 degrees F for sizes 1-1/2" to 12" elbows. Elbows shall be rated no less than 90% of straight connections.
5. Sizes 10" to 12" to employ control cables with neoprene end fittings isolation from anchor plates by means of ½" bridge bearing neoprene bushings.
6. Minimum safety factor, 4:1 at maximum pressure ratings.
7. Systems bolted to victaulic type couplings or gate, butterfly, or check valves to have a minimum 5/8" flange spacer installed between conductor and coupling on flange.
8. Submittals to include test reports.
9. Mason Type Safeflex SFDEJ.

B. Flexible Stainless Hose, Type FC-2:

1. Type 321 stainless steel braided flexible metal hose.
2. 2" pipe size and smaller: threaded carbon steel fittings.
3. 1 ½" pipe size and larger: Class 150 carbon steel flanges.
4. Suitable for operating pressure with 4:1 minimum safety factor.
5. Flexible Metal Hose Company type DFC and MFC.

C. Unbraided Exhaust Hose, Type FC-3:

1. Low pressure stainless steel annularly corrugated.
2. Fitted with flanged ends.
3. Maximum temperature 1,500 degrees F.
4. Mason Type SDL-RF.

PART 3 - EXECUTION

3.1 GENERAL SEISMIC RESTRAINT REQUIREMENTS:

A. Install seismic restraints in accordance with manufacturers recommendations.

B. Seismic restraining system Type III: Install taut for non-isolated equipment and slack with ½" cable deflection for isolated systems.

C. Seismically restrain all piping, conduit and ductwork with Type III or Type V seismic restraint in accordance with guidelines outlined below. Restraints which are to be used in conjunction with vibration isolators shall be Type III.

1. Carbon steel piping shall be braced at maximum 40' intervals and at turns of more than 4'. Lateral bracing at maximum 80' intervals. No-hub piping to be braced at maximum 20' intervals or maximum 40' using ½ G acceleration rated couplings.

2. Ductwork shall be braced at maximum 30' and at every turn and duct run end. Lateral bracing at maximum 60'.

D. Equipment mounted on housekeeping pads: Pads shall be properly doweled or expansion shielded to deck to meet acceleration criteria. Mason Type HPA.

E. Seismic Restraints are not required for the following:

1. Piping in mechanical rooms or penthouses less than 1-1/4" O.D, except fire protection and gas piping.
2. Piping in other areas less than 2-1/2" O.D. except fire protection and gas piping.
3. Ducts which have a cross sectional area less than 6 square feet.
4. All piping suspended by individual hanger 12" or less in length from the top of the pipe to the bottom of the support for the hanger, except fire protection piping.
5. Fire protection feed mains and cross mains suspended by individual hangers 6" or less in length from the top of the pipe to the bottom of the support for the hanger.
6. All top supported ducts suspended by hangers 12" or less in length from the top of the duct to the bottom of the support for the hanger.

7. Electrical conduit less than 1-1/2" I.D.

F. For overhead supported equipment, over stress of the building structure must not occur. Bracing can occur from:

1. Flanges to structural beams.
2. Upper or lower truss chords in bar joist construction at panel points.
3. Cast-in-place inserts or drilled and shielded inserts in concrete structures.

G. Building seismic and/or expansion joints: Install hinged joints at piping crossing expansion joints or fire walls and anchor the piping either side per the detail provided on the contract drawings. Anchors on each end are to be capable of accepting 1.5 times the operating pressure multiplied by the projected area of the pipe. Contractor shall refer to Contract Documents for fire wall and seismic/expansion joint location.

1. Offset shall be accomplished by the annular motion of a double sphere connector (TYPE FC-1) bolted to each end of an intermediate steel pipe. Bracket each joint with hinged steel connections. Hinge shall have a pin / slot assembly on both sides. The completed assembly shall be Mason Type Safeflex SFDEJ-HE.

3.2 GENERAL VIBRATION ISOLATION REQUIREMENTS:

A. Install isolators in accordance with manufacturer's recommendations. Vibration isolators shall not cause any change of position resulting in stresses or misalignment.

B. Mechanical equipment shall be isolated from the building structure by means of noise and vibration isolators.

C. Each fan and motor assembly shall be supported on a single structural steel frame (where noted on the isolation and seismic schedule). Flexible duct connections shall be provided at inlet and discharge ducts.

D. Provide pairs of horizontal limit springs (Thrust restraints) on fans with more than 6.0 inch static pressure, and on hanger supported, horizontally mounted axial fans where indicated

E. Provide resiliently mounted equipment, piping, and ductwork with seismic snubbers. Each inertia base shall have minimum of four seismic snubbers located close to isolators.

Snub equipment designated for post disaster use to 0.05 inch (1.5 mm) maximum clearance. Other snubbers shall have clearance between 0.15 inch (4 mm) and 0.25 inch (7mm).]

F. Ductwork connected to rotating equipment shall be supported with Type C or Type F isolators for the first three support points.

G. Installation of piping vibration isolators:

1. All piping, except fire protection standpipe systems, is included under this section.

2. Vibration isolators shall be installed on all piping outside the shafts as follows:

a. Piping in mechanical rooms.
b. Piping where exposed on roof.
c. Piping connected to rotating equipment and pressure reducing stations.

3. Horizontal suspended pipe 2" and smaller and all steam piping shall be suspended by Type E isolator with a minimum 3/8" deflection. Water pipe larger than 2" shall be supported by Type C or Type F isolator with minimum 1" whichever is greater.

4. Horizontal pipe floor supported at slab shall be supported via Type A with a minimum static deflection of 1" or same deflection as isolated equipment to which pipe connects, whichever is greater.

5. Vertical riser pipe supports under 2" diameter shall utilize Type G isolation pads.

6. Vertical riser guides, if required, shall avoid direct contact of piping with building.

7. Pipe anchors or guides, where required, shall utilize resilient pipe anchors, Mason Industries Type ADA, or equivalent, to avoid direct contact of piping with building.

8. Isolated piping which requires sway bracing shall utilize two neoprene elements, Type G to accommodate tension and compression forces.

9. Pipe extension and alignment connectors: Provide connectors at riser takeoffs, cooling and heating coils, and elsewhere as required, to accommodate thermal expansion and misalignment.

H. Pipe Isolation Schedule

PIPE SIZE - INCH (MM)	ISOLATED DISTANCE FROM EQUIPMENT
1 (25)	120 diameters (3.0m)
2 (50)	90 diameters (4.5m)
3 (80)	80 diameters (6.0m)
4 (100)	75 diameters (7.5m)
6 (150)	60 diameters (9.0m)
8 (200)	60 diameters (12.0m)
10 (250)	54 diameters (13.5m)
12 (300)	50 diameters (15.0m)
16 (400)	45 diameters (18.0m)
24 (600)	38 diameters (23.0m)

3.3 EQUIPMENT INSTALLATION:

A. Requirements for installation on concrete inertia bases shall be as follows:

1. Minimum operating clearance between concrete inertia and base and housekeeping pad or floor shall be 1".
2. The equipment structural steel or concrete inertia base shall be placed in position and supported temporarily by blocks or shims, as appropriate, prior to the installation of the machine or isolators.
3. The isolators shall be installed without raising the machine and frame assembly.

4. After the entire installation is complete and under full operational load, the isolators shall be adjusted so that the load is transferred from the blocks to the isolators. When all isolators are properly adjusted, the blocks or shims shall be barely free and shall be removed.
5. Install equipment with flexibility in wiring connection.
6. Verify that all installed isolator and mounting systems permit equipment motion in all directions. Adjust or provide additional resilient restraints to flexibly limit start-up equipment lateral motion to ¼".
7. Prior to start-up, clean out all foreign matter between bases and equipment. Verify that there are no isolation short circuits in the base, isolators, or seismic restraints.

3.4 INSPECTION:

A. Upon completion of the installation of all vibration isolation and seismic restraints, the manufacturer's local representative shall visit the project job site, visibly inspect all installations and report, in writing, any and all deficiencies from the specifications. Any additional corrective measures required to put the system in total compliance shall be the responsibility of the installing contractor.

END OF SECTION 23 05 48

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.

B. The General Requirements in Section 200050 shall also govern the work under this Section.

C. Examine all drawings and data and coordinate the work of this Section with all related and adjoining work.

1.2 SCOPE OF WORK:

A. Provide all labor, materials, equipment and tools required to complete the work described and shown on the contract drawings.

PART 2 -PRODUCTS

2.1 PRODUCTS:

A. None required.

PART 3 - EXECUTION

3.1 GENERAL:

A. Work shall be performed only by a firm which employs certified testing, adjusting and balancing technicians as listed by the Sheet Metal Industry National Certification Board of TAB Technicians. The work may be performed by a certified Test, Adjusting and Balancing technician who may be assisted by other TAB technicians. This firm shall provide personnel trained and experienced in system balancing. This requirement will not be waived under any condition.

B. Before submitting system performance data for approval or acceptance, the firm shall perform all necessary tests and make all necessary adjustments as required to obtain the flow and distribution of air as called for on the Contract Documents.

C. The balance reports shall include the names, signatures and registration numbers of the technicians assigned to the project.

D. Before proceeding with any demolition work contractor shall measure and record existing air and water flows and pressure drops for all the systems that are part of the scope of work.

3.2 ACCEPTABLE FIRMS:

A. The following listed firms are approved to perform this work:

Environmental Testing and Balance
James Brennan Company
Technical Associates Group, Inc.
Wing's Testing and Balancing

B. Request to employ any other balancing and testing firm must be accompanied by a complete brochure of the firm listing previous installations successfully balanced, length of time in business, names and qualifications of employees and list of instruments available for use on the project.

3.3 AIR HANDLING SYSTEMS:

A. Prior to the start of balancing the firm shall check the rotation of all fans.

B. Check to verify that all backdraft dampers are free to open and close. All filters must be checked and, if dirty, they must be replaced before commencing balancing so as not to create excessive resistance to the system. The firm shall make any necessary changes in fan speed to obtain design system conditions and shall realign all belts when necessary.

C. This Section shall be responsible for identifying any necessary changes in pulleys and belts required to obtain proper air delivery and shall request additional dampers, splinters, turning vanes, turbulence vanes and other devices if necessary to obtain the correct air balance, all as directed by the Town or his Representative.

This Contractor shall advice the Mechanical Contractor of the required corrections to the air distribution system, so that the system will perform as designed. All corrective work shall be done at no additional cost to the Town.

D. The firm shall compile the following data for each air system insofar as they apply and shall include it on the final submittal:

FAN DESCRIPTIVE DATA

System Number
Location Served
Fan Size
Fan Make
Fan Horsepower
Motor Safety Factor
Heater Manufacturer & Size

FAN DESIGN & DELIVERED CONDITIONS

Fan Rpm
Motor Rpm
Total and/or external static pressure
Amperage
Voltage & Phase
Brake Horsepower
Cfm Supply
Cfm Return
Cfm Exhaust
Fresh Air Percent
Return Air Percent

SYSTEM DESIGN & DELIVERED CONDITIONS

Each outlet shall be identified as to location and area
Register or diffuser size
Register or diffuser factor

Register or diffuser free area, core area, or neck area
Design Cfm
Design Rpm
Final Rpm Reading
Final Cfm
Outlet manufacturer and type
Type of instrument and method used

E. The firm shall set all dampers of all types for proper air flow. No system causing objectionable air noise will be accepted. All hand volume dampers shall be marked at their final position. Balancing Contractor shall adjust blades on all the supply registers for the deflection indicated on drawings, so that the desired air circulation is achieved.

F. The firm shall provide all instruments and accessories required to perform the tests and shall make their own provisions for inserting the instruments. This section shall patch all test holes.

G. The firm shall notify the Town's Representative when they will start work. Prior to this time, the firm shall send their supervising engineer to the office of the Town or his Representative to review the design, desired operation, and method of balancing of the job.

H. Upon completion of the work, the firm shall certify that all systems are properly balanced and are delivering, returning or exhausting the required quantities. The firm shall deliver to the subcontractor five (5) copies of the test report for transmittal to the Owner's Representative.

I. Check all safety controls and record control sequences.

J. Check and record air temperatures.

K. Check scheduled air control record the operation by simulating complete operating cycle.

L. After completion of balancing, mark location of all final positions of dampers.

M. In addition to the above requirements, the final report shall include the following:

1. Static pressure reading across filters, coils, of each air handling system showing design and actual readings.
2. Measured suction, discharge and total static pressure for each fan.
3. Design and actual CFM from each outlet and return/exhaust.
4. Outside air, air on and off heating furnaces, air off cooling coils and terminal air supply temperatures for each air handling system.
5. Rated and actual motor current, in amperes, of every motor at full load conditions.

3.4 HYDRONIC SYSTEMS:

A. Prior to the start of balancing, the firm shall check the rotation of all pumps.

B. The firm shall compile the following data for each pump insofar as they apply and shall include it on the final submittal:

SYSTEM DESIGN & DELIVERED CONDITIONS
Flow (Gpm) through each pump
Inlet & Outlet temperature at 3-way valve
Flow (Gpm) through each coil
Inlet & Outlet Pressure at each coil

Inlet & Outlet temperature at each coil
Type of instrument and method used

3.5 INSTALLATION TOLERANCES:

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. Adjust heating system to the following tolerances:

1. Supply water temperature 80 degree F to 120 deg. F 0% to +10% of design value.

2. Supply water temperature 120 degree F to 160 deg. F -5% to +10% of design value.

3. Supply water temperature above 160 degree F -10% to +10% of design value.

3.6 FIELD VERIFICATION:

A. The design Engineer may request verification of data contained in the balancing report. If requested the TAB technician whose initials appear on the data sheets shall take outlet and inlet readings selected at random by the Engineer who will compare these readings to those in the submitted report. If the field verification is not satisfactory, the firm doing the TAB work shall completely rebalance the system and a new report shall be prepared and submitted for approval.

END OF SECTION 23 05 93

SECTION 23 07 00 - HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General Provisions of the Contract, including General and Supplementary Conditions and Division 01, General requirements, apply to the work specified in this Section.

B. The General Requirements in Section 200050 shall also govern the work under this Section.

C. Scope of Work: This Section contains details for the insulation of pipe and equipment installed under Division 23.

1.2 SUBMITTALS:

A. In accordance with Section 200050, the following items shall be submitted for approval.

Refrigerant and Condensate pipe insulation

1.3 MECHANICAL SYSTEMS INSULATION:

A. Furnish and install all thermal and protective insulation as specified herein for piping and equipment as shown on the drawings.

B. The following mechanical items shall be insulated:
Refrigerant piping (liquid and suction).
Condensate piping

1.4 SYSTEM PERFORMANCE

A. Insulation materials furnished and installed hereunder should meet the minimum thickness requirements of ASHRAE 90.1 (2010), "Energy Efficient Design of New Buildings," of the American Society of Heating, Refrigeration, and Air Conditioning Engineers. However, if other factors such as condensation control or personnel protection are to be considered, the selection of the thickness of insulation should satisfy the controlling factor.

B. Insulation materials furnished and installed hereunder shall comply with NFPA 255 and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with the following testing standard:

Underwriters' Laboratories, Inc. UL 723

Adhesives used for applying the sealed jackets shall also conform to these same ratings. The use of wheat paste or any other material not meeting these requirements will not be allowed.

1.5 QUALITY ASSURANCE

A. Insulation materials and accessories furnished and installed hereunder shall, where required, be accompanied by manufacturers' current submittal or data sheets showing compliance with applicable specifications.

B. Insulation materials and accessories shall be installed in a workmanlike manner by skilled and experienced workers who are regularly engaged in commercial insulation work.

C. All covering and insulating materials shall be manufactured by Johns Manville, Owens-Corning, Knauf, or Armstrong.

1.6 SEAMS:

A. On exposed insulation, all longitudinal seams shall be kept at the top and back of the pipe and circumferential joints shall be kept to a minimum. Raw end of insulation shall be concealed by neatly folding the ends of the jackets. Fittings, valve bodies and flanges shall be furnished with the same jacket materials used on adjoining insulation.

1.7 PRIOR TESTING:

A. Covering shall not be applied until all parts of the work have been tested by the Contractor and reviewed by the Engineer.

1.8 VAPOR BARRIER:

A. Vapor barrier shall be applied in accordance with the manufacturer's instructions to maintain the integrity of the vapor barrier on cold systems.

B. An approved vapor retarder mastic compatible with PVC must be applied between pipe insulation and fitting cover, and on fitting cover and throat overlap seam.

C. For fittings where operating temperature is below 45 deg. For where pipe insulation thickness is greater than 1 ½", two or more layers of Hi-Lo temp insulation inserts shall be installed beneath fitting cover.

1.9 METAL SHIELDS:

A. Metal shields, 16 gauge galvanized, shall be applied between hangers or supports and the pipe insulation. Shields shall be roll formed to fit the insulation and shall extend up to the center line of the pipe and the length specified for the insert. Insulation shall be rigid type for length of shield to prevent crushing.

1.10 DELIVERY AND STORAGE OF MATERIALS

A. All of the insulation materials and accessories covered by this specification shall be delivered to the job site and stored in a safe, dry place with appropriate labels and/or other product identification.

B. The contractor shall use whatever means are necessary to protect the insulation materials and accessories (wick material, sealing tape, etc) before, during, and after installation. No insulation

material shall be installed that has become damaged in any way. The contractor shall also use all means necessary to protect work and materials installed by other trades.

PART 2 - PRODUCTS

2.1 PIPING:

A. Insulate all new condensate lines with Owens-Corning Fiberglass ASJ with S.S.L. II, pipe insulation with double self-sealing lap having a factory applied jacket. All horizontal and vertical insulated piping located below 8'-0" AFF level and not protected with enclosures shall be protected with Zeston 2000 P.V.C. 30 Mil jacketing. Outdoor, exposed piping shall be protected with aluminum jacket.

B. Insulate condensate piping the same as for hot piping above except vapor seal all joints, seams, elbows and fittings.

C. For all insulated pipes, including refrigerant piping, exposed to weather apply a 16 mil embossed aluminum jacket with 2" overlap at longitudinal and circumferential joints. Secure in place with 3/4" x .015" aluminum band 18" on centers. All seams shall be sealed weather tight.

D. Foam insulation:
1. Piping and Fittings. MicroLok plain pipe insulation shall be wired or taped in place over clean, dry pipe with all joints butted firmly together. Vapor retarder shall be Micro-Lok AP-T plus.
2. The insulation shall be finished with metal jacketing with a laminated moisture retarder. Metal jacketing shall be overlapped 2 to 3 inches (51 to 76 mm) and held in place with sheet metal screws or metal bands.
3. Elbows and tees shall be finished with matching metal fitting covers. Other fittings in metal-jacketed systems shall be finished with conventional weather-resistant insulating materials with painted aluminum finish.

E. Insulate all refrigerant lines with Armacell foam insulation with vinyl protective coating. Acceptable substitutions are by Imcolock or Aeroflex.

F. Provide minimum insulation thickness in accordance with the following table.

Minimum Pipe Insulation

Piping System Types	Conductivity	Mean Rating temp	Fluid Temp. Range	Runout 2 in +	1 in. and less	1-1/4 to 1 1/2	2 to 4 in.	5 and Large
	BTUin/hsqftF	F	F	in.	in.	in.	in.	in.
Heating Systems								
Low Temp	.25-.29	125	120-200	0.5	1.0	1.0	2	2
Cooling Systems								

Chilled Water or	.22-.28	100	40-60	.75	1.0	1.0	1.5	1.5
Refrigerant	.22-.28	100	Below 40	1.0	1.0	1.5	1.5	1.5

Reinsulate duct where insulation has been disturbed under this contract and feather to remaining insulation.

2.2 REFRIGERANT INSULATION

A. Insulation shall be a flexible, closed-cell elastomeric pipe insulation: AP Armaflex, AC Accoflex. Adhesive shall be Armaflex 520, 520 Black or 520 BLV Adhesive. The insulation must conform to ASTM C534 Grade 1, Type I.
Insulation materials shall have a closed cell structure to prevent moisture from wicking which makes it an efficient insulation.
Insulation materials shall be manufactured without the use of CFC's, HFC's or HCFC's. It is also formaldehyde free, low VOCs, fiber free, dust free and resists mold and mildew.
Insulation materials shall have a flame-spread index of less than 25 and a smoke-developed index of less than 50 as tested in accordance with ASTM E 84. In addition, the products, when tested, shall not melt or drip flaming particles, and the flame shall not be progressive.
Insulation materials shall have a maximum thermal conductivity of 0.27 Btu-in./h-ft^2-°F at a 75°F mean temperature as tested in accordance with ASTM C 177 or ASTM C 518.
Insulation materials shall have a maximum water vapor transmission of 0.08 perm-inches when tested in accordance with ASTM E 96, Procedure A.

B. All liquid and suction lines shall be insulated continuously from a point 6" inside the display case to the suction service valve at the compressor.
All low temperature lines (+10°F and below) shall be insulated with a minimum of 1" wall thickness.
All medium and high temperature lines (above +10°F) shall be insulated with a minimum of 3/4" wall thickness.
Heat reclaim lines shall be insulated from the condensing unit to the heat reclaim units with 3/4" thickness.
All refrigerant copper lines must be free of extraneous chemicals such as corrosive cleaners or building materials' dust prior to the installation of the insulation. The insulation must be clean and dry prior to installation.
Refrigerant pipe shall be sealed while slipping on insulation to prevent foreign matter from entering the tube.

C. Insulation is to be slid onto pipe; longitudinal slitting of the insulation is not allowed except on mitered sections. Insulation shall be pushed onto pipe, not pulled.
Insulation shall be mitered, preadhered and longitudinally slit inside throat to fit over all P- traps, tees and elbows or bends over 90°.
All butt joints and mitered seams shall be adhered with full coverage of adhesive on both surfaces. Insulation shall not be stretched when adhering.

D. Insulation must be installed in an adequately ventilated area. It may be necessary to increase insulation thickness if adequate ventilation is not present, Do not crowd the insulation, allow for adequate air movement.
At the beginning, at every 12 to 18 feet, and at the ends of piping runs, the insulation shall be adhered directly to the copper using a 2" strip of adhesive. Insulation should not be adhered to the pipe at the extreme low points in any piping run.
Saddles shall be installed under all insulated lines at unistrut clamps, clevis hangers, or locations where insulation may be compressed.

E. Armafix IPH or NPH insulation pipe hangers can be installed at the compression loca- tions and the seams shall be sealed with Armaflex 520, 520 Black or 520 BLV contact adhesive. To minimize the movement of Armafix, it is recommended that a pair of non-skid pads

be adhered to the clamps. In addition, to prevent loosening of the clamps, use of an anti-vibratory fastener, such as a nylon-locking nut, is also recommended.
Wood dowels or blocks, of a thickness equal to the insulation, can be inserted and must be completely sealed into the insulation at the saddle locations. All seams shall be sealed with Armaflex 520, 520 Black or 520 BLV contact adhesive.
Hangers clamped directly to the pipe shall be insulated over the hanger; insulation shall be fully adhered to the hanger. In addition, hangers with double rods shall be insulated between the rods. All seams of the insulation shall be sealed with adhesive.
All insulation exposed to sunlight or installed outdoors shall be protected with two coats of WB Armaflex Finish or weather resistant coating and aluminum jacket.

2.3 FITTING COVERS:

A. Fitting covers may be used in lieu of insulating cement and jacket. Provide fitting covers in Zeston - 2000 P.V.C. (20 Mil thickness) by Manville. Provide color coded fitting covers in Zeston 300 Series 30 Mil jacket for fittings located in the Mechanical Rooms and Mechanical Penthousees. Acceptable substitutions are by SpeedLine or Proto.

B. General - The matching insert (fiberglass) should either be wrapped completely around the fitting or snugly positioned inside the fitting for proper fit. The insert shall cover the full inner surface area of the fitting cover. The fitting cover is then to be applied over the fitting and insert, and the throat secured by either tack fastening, taping, or banding.

C. Cold Pipe - Fitting systems below ambient temperature must have a continuous vapor barrier, either with pressure sensitive PVC Tape, or an approved adhesive system. When PVC Tape is used, a 2" downward lap is required. On cold lines in severe ambient temperatures, the fiberglass insert shall be the same thickness as the adjacent pipe insulation. All joints shall then be sealed with PVC Tape.

PART 3 – EXECUTION

3.1 SITE INSPECTION

A. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.

B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturer’s recommendations.

C. Verify, by inspecting product labeling, submittal data, and/or certifications which may accompany the shipments, that all materials and accessories to be installed on the project comply with applicable specifications and standards and meet specified thermal and physical properties.

3.2 PREPARATION

A. Ensure that insulation is clean, dry, and in good mechanical condition and that all factory-applied facings are intact and undamaged. Wet, dirty, or damaged insulation is not acceptable for installation.

B. Ensure that pressure testing of piping and fittings has been completed prior to installing insulation.

3.3 INSTALLATION

A. General

1. Install all insulation materials and accessories in accordance with manufacturer's published instructions and recognized industry practices to ensure that it will serve its intended purpose.

2. Install insulation on piping subsequent to painting, and acceptance tests.

3. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit over all piping surfaces.

B. Fittings

1. Wrap valves, fittings, and similar items in each piping system with wicking material to ensure a continuous path (100% coverage) for the removal of condensation.

2. Seal all fitting joints with contractor supplied VaporWick Sealing Tape or approved vapor retarder mastic compound.

C. Penetrations

Extend piping and duct insulation without interruption through walls, floors and similar piping or duct penetrations.

3.4 FIELD QUALITY ASSURANCE

A. Upon completion of all insulation work covered by this specification, visually inspect the work and verify that it has been correctly installed. This may be done while work is in progress, to assure compliance with requirements herein to cover and protect insulation materials during installation.

B. Replace any ceiling damage caused by condensation due to improper covering and sealing during the guarantee period of this job.

3.5 PROTECTION

A. Replace damaged, removed or disturbed insulation with appropriate fiberglass insulation.

B. The insulation contractor shall advise the general and/or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

3.6 SAFETY PRECAUTIONS

A. Insulation contractor's employees shall be properly protected during installation of all insulation. Protection shall include proper attire when handling and applying insulation materials, and shall include (but not be limited to) disposable dust respirators, gloves, hard hats, and eye protection.

B. The insulation contractor shall conduct all job site operations in compliance with applicable provisions of the Occupational Safety and Health Act, as well as with all state and/or local safety and health codes and regulations that may apply to the work.

END OF SECTION 23 07 00

SECTION 23 09 00 - DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The General Provisions of the Contract, including General and Supplementary Conditions and Division 01, General requirements, apply to the work specified in this Section.

B. The General Requirements in Section 200050 shall also govern the work under this Section.

C. Scope of Work: This Section contains details for the insulation of pipe and equipment installed under Division 23.

1.2 SUMMARY

A. Section Includes:
1. Manufacturer: Alerton – Compass. No other manufacturers allowed.
2. Building Automation System - Central Work Station
3. Global Controller
4. Central plant Controllers
5. Central Plant Expandable Controllers
6. Field Controller
7. Touch Screen Communicating Thermostat
8. Auxiliary Control Devices
9. Electronic Actuators and Valves
10. Enclosures
11. Control Wiring and Raceways
12. Accessories

1.3 DEFINITIONS

A. Algorithm: A logical procedure for solving a recurrent mathematical problem. A prescribed set of well-defined rules or processes for solving a problem in a finite number of steps.

B. Analog: A continuously varying signal value, such as current, flow, pressure, or temperature.

C. BACnet Specific Definitions:

1. BACnet: Building Automation Control Network Protocol, ASHRAE 135. A communications protocol allowing devices to communicate data over and services over a network.

2. BACnet Interoperability Building Blocks (BIBBs): BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device.
3. BACnet/IP: Defines and allows using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnetworks that share the same BACnet network number.
4. BACnet Testing Laboratories (BTL): Organization responsible for testing products for compliance with ASHRAE 135, operated under direction of BACnet International.
5. PICS (Protocol Implementation Conformance Statement): Written document that identifies the particular options specified by BACnet that are implemented in a device.

D. Binary: Two-state signal where a high signal level represents ON" or "OPEN" condition and a low signal level represents "OFF" or "CLOSED" condition. "Digital" is sometimes used interchangeably with "Binary" to indicate a two-state signal.

E. Controller: Generic term for any standalone, microprocessor-based, digital controller residing on a network, used for local or global control. Two types of controllers are indicated: Global Controller and field controller.

F. Control System Integrator: An entity that assists in expansion of existing enterprise system and support of additional operator interfaces to I/O being added to existing enterprise system.

G. COV: Changes of value.

H. DDC System Provider: Authorized representative of, and trained by, DDC system manufacturer and responsible for execution of DDC system Work indicated. DDC System Provider shall have having full-time in-house employees for the following:
1. Engineering: Engineering shall be responsible to generate a sequence of operations and control drawings based on the contract documents for the submittal process.
2. Programmer: Programmer shall be responsible to write the code into the controllers as required to execute the sequence of operations

I. Engineering utilized to generate sequence of operations and control drawings for the submittal process. and Programmer and shall be employed by authorized representative DDC installing contractor.

J. In-place facility located within 50 miles of Project and located within the State of Connecticut.

K. Distributed Control: Processing of system data is decentralized and control decisions are made at subsystem level. System operational programs and information are provided to remote subsystems and status is reported back. On loss of communication, subsystems shall be capable of operating in a standalone mode using the last best available data.

L. I/O: System through which information is received and transmitted. I/O refers to analog input (AI), binary input (BI), analog output (AO) and binary output (BO). Analog signals

are continuous and represent control influences such as flow, level, moisture, pressure, and temperature. Binary signals convert electronic signals to digital pulses (values) and generally represent two-position operating and alarm status. "Digital," (DI and (DO), is sometimes used interchangeably with "Binary," (BI) and (BO), respectively.

M. LAN: Local area network.

N. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

O. Modbus TCP/IP: An open protocol for exchange of process data.

P. MS/TP: Master-slave/token-passing, IEE 8802-3. Datalink protocol LAN option that uses twisted-pair wire for low-speed communication.

Q. MTBF: Mean time between failures.

R. Global Controller: The controller shall be capable of providing global control strategies for the system based on information from any objects in the system. S. The controller shall be capable of running up to six (6) independent control strategies simultaneously. The modification of one control strategy does not interrupt the function or runtime others.

S. Field Controllers: Provide one native BACnet application controller for each piece of unitary mechanical equipment that adequately covers all objects listed in object list for unit. All controllers shall interface to global controller through MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include I/O and self-contained logic program as needed for complete control of unit.

T. Network Repeater: Device that receives data packet from one network and rebroadcasts it to another network. No routing information is added to protocol.

U. Programmer: A full-time in-house employees of the authorized representative DDC installing contractor. Personnel responsible to develop the following:
1. Graphics
2. Implement sequence of operations utilize the programing tools within the software.
3. Trend and alarm list as determined by the Engineer.

V. PDA: Personal digital assistant.

W. Peer to Peer: Networking architecture that treats all network stations as equal partners.

X. POT: Portable operator's terminal.

Y. PUE: Performance usage effectiveness.

Z. RAM: Random access memory.

AA. RF: Radio frequency.

BB. Router: Device connecting two or more networks at network layer.

CC. Server: Computer used to maintain system configuration, historical and programming database.

DD. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

EE. UPS: Uninterruptible power supply.

FF. USB: Universal Serial Bus.

GG. User Datagram Protocol (UDP): This protocol assumes that the IP is used as the underlying protocol.

HH. VAV: Variable air volume.

II. WLED: White light emitting diode.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 SUBMITTALS

A. Product Data: For each type of product include the following:
1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation, operation and maintenance instructions including factors effecting performance.
5. Bill of materials of indicating quantity, manufacturer, and extended model number for each unique product.
    a. Operator workstations.
    b. Servers.
    c. Printers.
    d. Gateways.
    e. Routers.
    f. Protocol analyzers.
    g. DDC controllers.
    h. Enclosures.
    i. Electrical power devices.
    j. UPS units.
    k. Accessories.
    l. Instruments.
    m. Control dampers and actuators.

n. Control valves and actuators.

6. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.
7. Each submitted piece of product literature shall clearly cross reference specification and drawings that submittal is to cover.

B. Software Submittal:
1. Cross-referenced listing of software to be loaded on each operator workstation, server, gateway, and DDC controller.
2. Description and technical data of all software provided, and cross-referenced to products in which software will be installed.
3. Operating system software, operator interface and programming software, color graphic software, DDC controller software and maintenance management software.
4. Description of each network communication protocol.

C. Shop Drawings:
1. General Requirements:
   a. Include cover drawing with Project name, location, Owner, Architect, Contractor and issue date with each Shop Drawings submission.
   b. Include a drawing index sheet listing each drawing number and title that matches information in each title block.
   c. Prepare Drawings using CAD.
   d. Drawings Size: 11 inches by 17 inches.
2. Schematic drawings for each controlled HVAC system indicating the following:
   a. I/O points labeled with point names shown.
   b. A graphic showing location of control I/O in proper relationship to HVAC system.
   c. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
   d. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays and interface to DDC controllers.
   e. Graphic sequence of operation, showing all inputs and output logical blocks.

D. System Description:
1. Full description of DDC system architecture, network configuration, operator interfaces and peripherals, servers, controller types and applications, gateways, routers and other network devices, and power supplies.
2. Complete listing and description of each report, log and trend for format and timing and events which initiate generation.
3. Description of testing plans and procedures.
4. Description of Owner training.

E. Qualification Data:

1. Systems Provider Qualification Data:

   a. Resume of programmer assigned to Project.

b. Resumes of application engineering staff assigned to Project.
c. Description of past project DDC system, noting similarities to Project scope and complexity indicated.
d. Owner contact information for past project including name, phone number, and e-mail address.
e. for past project including name, phone number, and e-mail address.
f. Architect and Engineer contact information for past project including name, phone number, and e-mail address.

F. Product Certificates:
1. Data Communications Protocol Certificates: Certifying that each proposed DDC system component complies with ASHRAE 135.

G. I. Sample Warranty: For manufacturer's warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For DDC system to include in emergency, operation and maintenance manuals.
1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
a. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format.
b. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.
c. As-built versions of submittal Product Data.
d. Names, addresses, e-mail addresses and 24-hour telephone numbers of Installer and service representatives for DDC system and products.
e. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control and changing set points and variables.
f. Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
g. Engineering, installation, and maintenance manuals that explain how to:
1) Design and install new points, panels, and other hardware.
2) Perform preventive maintenance and calibration.
3) Debug hardware problems.
4) Repair or replace hardware.
h. Documentation of all programs created using custom programming language including tuning parameters, and object database.
i. Backup copy of graphic files, programs, and database on electronic media such as DVDs.
j. Licenses, guarantees, and warranty documents.
k. Owner training materials.

1.7 QUALITY ASSURANCE

A. DDC System Manufacturer Qualifications:
   1. Nationally recognized manufacturer of DDC systems and products.
   2. DDC systems with similar requirements to those indicated for a continuous period of 10 years within time of bid.
   3. DDC systems and products that have been successfully tested and in use on at least one hundred past projects.
   4. Having complete published catalog literature, installation, operation and maintenance manuals for all products intended for use.
   5. Having full-time in-house employees for the following:
      a. Product research and development.
      b. Product and application engineering.
      c. Technical support for DDC system installation training, commissioning and troubleshooting of installations.

B. DDC System Provider Qualifications:
   1. Authorized representative of, and trained by, DDC system manufacturer.
   2. DDC system provider shall have in-house employee for engineering staff and programmer.
   3. In-place facility located within 50 miles of Project and located within the State of Connecticut.
   4. Demonstrated past experience with installation of DDC system products being installed for period within five consecutive years before time of bid.
   5. Demonstrated past experience on twenty projects of similar complexity, scope and value.
   6. Each person assigned to Project shall have demonstrated past experience.
   7. Staffing resources of competent and experienced full-time employees that are assigned to execute work according to schedule.
   8. Service and maintenance staff assigned to support Project during warranty period.
   9. Product parts inventory to support on-going DDC system operation for a period of not less than 5 years after Substantial Completion.
   10. DDC system manufacturer's backing to take over execution of Work if necessary to comply with requirements indicated. Include Project-specific written letter, signed by manufacturer's corporate officer, if requested

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace products that fail in materials or workmanship within specified warranty period.
   1. Failures shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner.
   2. Include updates or upgrades to software and firmware if necessary to resolve deficiencies.
      a. Install updates only after receiving Owner's written authorization.
   3. Warranty service shall occur during normal business hours and commence within 24 hours of Owner's warranty service request.
   4. Warranty Period: Eighteen months from date of Substantial Completion.

B. QUALITY ASSURANCES

1. The Building Automation System (BAS) system shall be designed, installed, and serviced by manufacturer authorized and trained personnel. System provider shall have an in-place support facility within 2 hours response time of the site with technical staff, spare parts inventory, and necessary test and diagnostic equipment.
2. The contractor shall provide full-time, on-site, experienced project manager for this work, responsible for direct supervision of the design, installation, start-up and commissioning of the BAS system.
3. Bidders shall provide a list of at least 10 projects, similar in size and scope to this project completed within the past 3 years.
4. Materials and equipment shall be manufacturer's latest standard design that complies with the specification requirements.
5. All BAS peer-to-peer network controllers, central system controllers and local user displays shall be UL Listed under Standard UL 916, category PAZX.
6. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.
7. Control system shall be engineered, programmed and supported completely by representative's local office that must be within 100 miles of project site.

C. WARRENTY

1. Warranty shall cover all costs for parts, labor, associated travel, and expenses for a period of one year from completion of system acceptance.
2. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the vendor. The maximum acceptable response time to provide this service at the site shall be 24 hours, Monday through Friday and 48 hours on Saturday and Sunday.
3. This warranty shall apply equally to both hardware and software.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The Building Automation System shall be the Alerton Compass BACtalk system from Alerton. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alerton – Compass. Automated Building Systems: 860-657-9257.

2. No others control system will be allowed.

2.2 BUILDING AUTOMATION SYSTEM - CENTRAL WORK STATION (BAS-CWS)

A. Provide a building automation system to control the system as defined for the project and to allow all objects as defined by ASHRAE Standard SPC-135A/95 to be sent to the existing Alerton Building Automation School District Wide server. The project's graphics and software must be programmed into the existing Alerton BACnet Building Automation School server and must utilize identical programming and graphic software as already exists.

B. General structure of workstation interaction shall be a standard client/server relationship with web server embedded in the server for browser only access. Server shall be used to archive data and store system database. The DDC-CWS shall support operation in a virtualized server environment. Thick and web clients shall access server for all archived data.

1. A single server license shall:
   a. Allow a minimum of 50 thick client seats/installations.
   b. Allow a minimum of 200 web client users.
   c. Not restrict system size based on point count (BACnet or Integration).

C. Data Displays

1. Data displays shall render all data associated with project as called out on drawings and/or object type list supplied. Graphic files shall be created using digital, full color photographs of system installation, AutoCAD or Visio drawing files of field installation drawings, and wiring diagrams from as-built drawings.

2. Data displays shall render data using iconic graphic representations of all mechanical equipment. System shall be capable of displaying graphic file, text, trendlog, and dynamic object data together on each display and shall include animation. Information shall be labeled with descriptors and shall be shown with the appropriate engineering units. All information on any display shall be dynamically updated without any action by the user.

3. Data display frame shall allow user to change all field-resident BAS-CWS functions associated with the project, such as setpoints, weekly schedules, exception schedules, etc., from any screen, no matter if that screen shows all text or a complete graphic display. This shall be done without any reference to object addresses or other numeric/mnemonic indications.

4. Analog objects shall be displayed with operator modifiable units. Analog input objects may also be displayed as individual graphic items on the display screen as an overlay to the system graphic.

5. All displays and programming shall be generated and customized by the local use energy management and control system (EMCS) supplier and installer. Systems requiring factory development of graphics or programming of direct digital control (DDC) logic are specifically prohibited.

6. BAS-CWS shall be supplied with a library of standard graphics, which may be used unaltered or modified by the operator. BAS-CWS shall include a library of equipment graphic components to assemble custom graphics. Systems that do not allow

customization or creation of new graphic objects by the operator (or with third-party software) shall not be allowed.

7. A navigation tree for building, equipment and system diagnostic centric display organization shall be available from data display view. The tree navigation contents shall be customizable on a per-user and per-group basis.

8. Each display may be protected from viewing unless operator credentials have the appropriate access level. An access level may be assigned to each display and system object. The menu label shall not appear on the graphic if the operator does not have the appropriate security level.

9. Data displays shall have the ability to link to content outside of the EMCS system. Such content shall include, but is not limited to launching external files in their native applications (for example, a Microsoft Word document).

10. A single system software license can support a minimum of 200 user accounts and web access.

11. Data displays shall support:
    a. Graphic items with custom geometry that offer both color gradient shading and variable opacity in scale to system variables, both analog and digital, and color range settings. For example, rooms on a floor plan graphic can be made to indicate the space temperature by varying the color of that room.
    b. Clear and custom geometry navigation buttons to provide intuitive navigation to system display or external URLs.
    c. Graphic files in JPG, PNG, and GIF file types.
    d. Viewing of up to 1,024 system data points (Analog, Binary, and/or Multi-state) in a single screen.
    e. Customizable mouse-over tooltip information of graphic items or data points can be displayed. The tooltips can be turned on and off. The default setting is off.
    f. Right click capability to directly access system functionality, such as Schedule, Trendlogs, and Alarms associated with a display object selected.
    g. Automatic zooming to the screen size detected to maximize the size of the display to match screen display area available. The zoom capability can be enabled or disabled, default is enabled. The background color, if solid, will be used to flood fill the remaining screen background.
    h. Supports user configurable embedded Data Viewer for a persistent trend log data view to accompany system data and graphic information on a single display.

D. Password Protection

1. Provide security system that prevents unauthorized use unless operator is logged on. Access shall be limited to operator’s assigned functions when user is logged on. This includes displays as outlined above.

2. BAS-CWS shall provide security for a minimum of 200 users. Each user shall have an individual User ID, User Name, and Password. Entries are alphanumeric characters only and are case sensitive (except for User ID). User ID, User Name, and Password shall be

shall support a minimum of 40 characters. All user information and passwords shall be stored in an encrypted form.

3. Each user shall be allowed individual assignment of only those control functions, menu items, navigation tree, and user-specific system start display, as well as restricted access to discrete BACnet devices to which that user requires access.

4. All passwords, user names, and access assignments shall be adjustable via Server and Thick client. Password shall be adjustable via the web client.

5. Users shall also have a set access level, which defines access to displays and individual objects the user may control. System shall include 10 separate and distinct access levels for assignment to users.

6. The BAS-CWS and Thick Client shall include an Auto Logout feature that shall automatically logout user when there has been no keyboard or mouse activity for a set period of time. Time period shall be adjustable by system administrator. Auto Logout may be enabled and disabled by system administrator. Operator terminal shall display message on screen that user is logged out after Auto Logout occurs.

7. The system shall permit the assignment of an effective date range, as well as an effective time of day, that the User IDs are permitted to authenticate.

E. Operator Activity Log

1. An Operator Activity Log that tracks all operator changes and activities shall be included with BAS-CWS. System shall track what is changed in the system, who performed this change, date and time of system activity, and value of the change before and after operator activity. Operator shall be able to display all activity, sort the changes by user and also by operation. Operator shall be able to print the Operator Activity Log display.

2. Log shall be gathered and archived to a hard drive on BAS-CWS as needed. Operator shall be able to export data for display and sorting in a spreadsheet.

3. System shall have the option to require user comment recording in the Operator Activity Log upon any system point change.

4. Operator Activity log shall be accessible via the Web Client for viewing, sorting, filtering, and Printing.

F. Scheduling

1. BAS-CWS, Thick Client and Web Client shall show all information in easy-to-read daily format including calendar of this month and next. All schedules shall show actual ON/OFF times for day based on scheduling priority. Priority for scheduling shall be events, holidays and daily, with events being the highest.

2. Holiday and special event schedules shall display data in calendar format. Operator shall be able to schedule holidays and special events directly from these calendars.

3. Operator shall be able to change all information for a given weekly or exception schedule if logged on with the appropriate access privileges.

4. BAS-CWS and Thick Client shall include a Schedule Wizard for set up of schedules. Wizard shall walk user through all steps necessary for schedule generation. Wizard shall have its own pull-down selection for startup or may be started by right-clicking on value displayed on graphic and then selecting Schedule.

5. Scheduling shall include optimum start based on outside air temperature, current heating/cooling setpoints, indoor temperature and history of previous starts. Each and every individual zone shall have optimum start time independently calculated based on all parameters listed. User shall input schedules to set time that occupied setpoint is to be attained. Optimum start feature shall calculate the startup time needed to match zone temperature to setpoint. User shall be able to set a limit for the maximum startup time allowed.

6. Schedule list shall show all schedules currently defined. This list shall include all standard, holiday and event schedules. In addition, user shall be able to select a list that shows all scheduled points and zones.

7. Display of all three schedules must show all ON times for standard, holiday and event schedules in different colors on a given day. In addition, OFF times for each must also be shown in additional colors. User shall be able to select from standard calendar what days are to be scheduled and same display shall show all points and zones affected. User shall be able to set time for one day and select all days of the week that shall be affected as a recurrence of that same schedule for that given day.

8. Any displayed data that is changeable by the operator may be selected using the right mouse button and the schedule shall then be selectable on the screen. Selection of the schedule using this method shall allow the viewing of the assigned schedule allow the point to be scheduled.

9. Schedule editor shall support drag-n-drop events and holidays onto the schedule calendar.

10. Schedule editor shall support drag-n-drop events default to a two-hour period, which can then be adjusted by the user.

11. Schedule editor shall support drag-n-drop holidays default for OFF all day and can be edited for multiple-day holidays.

12. Schedule editor shall support the view of affected zones when adding or editing timed events of a schedule.

13. The web client shall have the ability to search a list of all scheduled points and zones to access the schedule calendar.

14. Schedule time blocks shall present schedule detail via mouse-over information.

G. Alarm Indication and Handling

1. BAS-CWS shall provide visual, printed, and email means of alarm indication. Printout of alarms shall be sent to the assigned terminal and port. Alarm notification can be filtered based on the User ID's authorization level.

2. Web client shall display a persistent alarm state for the system regardless of the data view including points in alarm but not acknowledged, and points that have gone into alarm and returned to normal without being acknowledged.

3. Alarm History shall provide log of alarm messages. Alarm log shall be archived to the hard disk of the BAS-CWS. Each entry shall include a description of the event-initiating object generating the alarm. Description shall be an alarm message of at least 256 characters in length. Entry shall include time and date of alarm occurrence, time and date of object state return to normal, time and date of alarm acknowledgment, and identification of operator acknowledging alarm.

4. Alarm messages shall be in user-definable text (English or other specified language) and shall be delivered either to the operator's terminal, client or through remote communication using email (Authenticated SMTP supported).

5. BAS-CWS, Thick Client, and Web Client shall allow for set up of alarms. UI shall walk user through all steps necessary for alarm generation. Alarm creation may be started by right-clicking on value displayed on graphic and then selecting Alarm setup.

6. Web client shall support color-coded indication of current alarms as follows:
   a. Red indicator shows number of active alarms that have not been acknowledged.
   b. Yellow indicator shows number of alarms that are still active but have been acknowledged.
   c. Blue indicator shows number of alarms that have returned to normal but have not been acknowledged.
   d. Color-coded indicators, when selected by the user, navigate to a pre-filtered view of alarm history.
   e. Alarm history can be filtered by color-coded indicator states.

7. Alarm annunciation includes navigation link to a user-selected display or URL.

8. Any displayed data that is changeable by the operator may be selected using the right mouse button and the alarm shall then be selectable on the screen. Selection of the alarm using this method shall allow the viewing of the alarm history or allow the creation of a new alarm.

H. Trendlog Information

1. BAS-CWS shall periodically gather historically recorded data stored in the global controllers and store the information in the system database. Stored records shall be appended with new sample data, allowing records to be accumulated. Systems that write over stored records shall not be allowed unless limited file size is specified. System database shall be capable of storing up to 50 million records before needing to archive

data. Samples may be viewed at the web client. All trendlog records shall be displayed in standard engineering units.

2. BAS-CWS shall be capable of trending on an interval determined by a polling rate, or change-of-value.

3. BAS-CWS, Thick client, or Web Client shall be able to add and edit trendlogs and the setup information. This includes the information to be logged as well as the interval at which it is to be logged. All operations shall be password protected. Viewing may be accessed directly from any and all graphics on which a trended object is displayed.

4. BAS-CWS and Thick Client shall include a Trendlog Wizard for setup of multiple trend logs simultaneously. Wizard shall walk user through all necessary steps. Wizard shall have its own pull-down selection for startup, or may be started by right-clicking on value displayed on graphic, and then selecting Trendlogs from the displayed menu.

5. BAS-CWS shall be capable of using Microsoft SQL as the system database.

6. Any displayed data that is changeable by the operator may be selected using the right mouse button and the trendlog shall then be selectable from a menu on the screen. Selection of the trendlog using this method shall allow the viewing of the trendlog data in the DataViewer.

7. DataViewer shall provide:
    a. Software that is capable of graphing the trend-logged object data shall be included.

    b. Access and ability to create, edit and view are restricted to users by user account credentials

    c. Specific and repeatable URL defines the trendlog(s) views for browser bookmarking and email compatibility.

    d. Call out of trendlog value at intersection of trend line and mouse-over vertical axis.

    e. Trendlog or Energy log and companion logs can be configured to display on one of two independent vertical scales embedded in the display.

    f. Click zoom for control of data set viewed along either graph axis.

    g. User-specifiable start and end dates as well as a fast scroll features that supports click zoom of macro scale view of the data for quickly finding data set based on visual signature.

    h. User export of the viewed data set to MS Excel.

    i. Web browser-based help.

    j. Optional min/max ranges (Upper Control Limits, Lower Control Limits) for each value.

I. Reports

1. BAS-CWS shall be capable of periodically producing reports of trendlogs, alarm history, tenant activities, device summary, energy logs, and override points. The frequency, content, and delivery are to be user adjustable.

2. All reports shall be capable of being delivered in multiple formats including text- and comma-separated value (CSV) files. The files can be printed, emailed, or saved to a folder, either on the server hard drive or on any network drive location.

J. Configuration/Setup

1. Provide means for operator to display and change system configuration. This shall include, but not be limited to system time, day of the week, date of daylight savings set forward/set back, printer termination, port addresses, modem port and speed, etc. Items shall be modified using understandable terminology with simple mouse/cursor key movements.

2. The building management system (BMS) shall operate the user interface in any region and support varying languages and locale settings, without the addition of special software. Localization tools shall be commonly available open sourced or purchased products, No BMS manufacturer specific software will be acceptable.

a. The following localization capabilities shall be supported:

i. Locale settings related to date, time and number formats
ii. Multiple left-to-right languages supported including Cyrillic languages
iii. On the fly locale change using browser language settings (multiple language and locale setting change)
iv. Default character encoding shall be UTF-8
v. Each localized BMS element can be localized independently and operate autonomously

K. Field Engineering Tools

1. BAS-CWS shall include field engineering tools for programming all controllers supplied. All controllers shall be programmed using graphical tools that allow the user to connect function blocks on screen that provide sequencing of all control logic. Function blocks shall be represented by graphical displays that are easily identified and distinct from other types of blocks. Graphical programming that uses simple rectangles and squares is not acceptable.

2. User shall be able to select a graphical function block from menu and place on screen. Provide zoom in and zoom out capabilities. Function blocks shall be downloaded to controller without any reentry of data.

3. Programming tools shall include a real-time operation mode. Function blocks shall display real-time data and be animated to show status of data inputs and outputs when in real-time operation. Animation shall show change of status on logic devices and countdown of timer devices in graphical format.

4. Field engineering tools shall also include a database manager of applications that include logic files for controllers and associated graphics. Operator shall be able to select unit type, input/output configuration and other items that define unit to be controlled. Supply minimum of 250 applications as part of workstation software.

5. Field engineering tool shall include Device Manager for detection of devices connected anywhere on the BACnet network by scanning the entire network. This function shall display device instance, network identification, model number, and description of connected devices. It shall record and display software file loaded into each controller. A copy of each file shall be stored on the computer's hard drive. If needed, this file shall be downloaded to the appropriate controller using the mouse.

6. BAS-CWS shall automatically notify the user when a device that is not in the database is added to the network.

7. BAS-CWS shall include backup/restore function that will back up entire system to selected medium and then restore system from that medium. The system shall be capable of creating a backup for the purpose of instantiating a new client PC.

8. The system shall provide a means to scan, detect, interrogate, and edit third-party BACnet devices and BACnet objects within those devices.

L. Workstation Hardware

1. BAS-CWS Server Minimum Requirements
    a. 64-bit OS
    b. Windows 7, Windows 8.1, Windows 10, Windows Server 2008R2, or Windows Server 2012R2
    c. 2 GHz (or better), dual-core or quad-core processors
    d. 4 GB RAM or higher
    e. 3 GB of hard drive space required for base installation without application data
    f. Network interface card (10/100/1000 Mbps)

M. Software

1. At the conclusion of the project, contractor shall leave with owner a electronic copy that includes the complete software operation system and project graphics, setpoints, system parameters, etc. This backup shall allow the owner to completely restore the system in the case of a computer malfunction.

N. Web Client

1. EMCS supplier shall provide an HTML5-based browser access to the BAS-CWS as part of standard installation. User must be able to access all displays of real-time data that are part of the BAS-CWS using a standard web browser. Web browser shall tie into the network through owner-supplied Ethernet network connection. The web client shall support a minimum of 200 users with a single license.

2. Browser shall be standard version of Microsoft Internet Explorer v10.0 or later, Firefox v19.0 or later, Chrome v24.0 or later, and Safari v7.1.1 or later. No special vendor-

supplied software shall be needed on computers running browser. Data shall be displayed in real-time and update automatically without user interaction.

3. Web pages shall be automatically generated using HTML5 from the data display files that reside on the BAS-CWS. Any system that requires use of an HTML editor for generation of web pages shall not be considered.

4. Access through web client or thick client shall utilize the same hierarchical security scheme as the BAS-CWS. User shall be asked to log on once the client makes connection to the BAS-CWS. Once the user logs on, any and all changes that are made shall be tracked by the BAS-CWS. The user shall be able to change only those items he or she has authority to change. A user activity report shall show any and all activity of the users who have logged on to the system, regardless of whether those changes were made using a web client, thick client or through the BAS-CWS.

5. Shall provide User Session Management including the ability to view all connected user sessions to the web client, see how long they have been active/inactive for each unique session, and force log-out for any or all sessions.

6. Shall provide menu-style navigation access to primary features, i.e. alarm history, DataViewer, Search scheduled points and Zones, System Activity, User Session Management, and Top Display

7. Web client shall, at a minimum, support the following tablets:
   a. Android platform:
      1) Google Nexus
      2) Samsung Galaxy Note
   b. Apple platform
   c. Ipad
   d. Apple Ipad Mini

2.3 GLOBAL CONTROLLER

A. General Requirements

1. BACnet Conformance
   a. Global controller shall be approved by the BTL as meeting the BACnet Global controller requirements.
   b. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

2. Global controller shall be of scalable design such that the number of trunks and protocols may be selected to fit the specific requirements of a given project.

3. The controller shall be capable of panel-mounted on DIN rail and/or mounting screws.

4. The controller shall be capable of providing global control strategies for the system based on information from any objects in the system, regardless if the object is directly monitored by the global controller module or by another controller.

5. The controller shall be capable of running up to six (6) independent control strategies simultaneously. The modification of one control strategy does not interrupt the function or runtime others.

6. The software program implementing the DDC strategies shall be completely flexible and user-definable. All software tools necessary for programming shall be provided as part of project software. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site, using a wide area network (WAN) or downloaded through remote communications are not acceptable. Changing global strategies using firmware changes is also unacceptable.

7. Programming shall be object-oriented using control function blocks and support DDC functions. All flowcharts shall be generated and automatically downloaded to controller. Programming tool shall be supplied and be resident on workstation. The same tool shall be used for all controllers.

8. The programming tool shall provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed using the operator's workstation or field computer.

9. Controller shall have 6,000 Analog Values and 6,000 Binary Values.

10. Controller IP configuration can be done via a direct USB connect with an operator's workstation or field computer.

11. Controller shall have at a minimum a Quad Core 996Ghz processor to ensure fast processing speeds.

12. Global control algorithms and automated control functions shall execute using a 64-bit processor.

13. Controller shall have a minimum of 1 GB of DDR3 SDRAM on a 533Mhz bus to ensure high speed data recording, large data storage capacity and reliability.

14. Controller shall support two (2) on-board EIA-485 ports capable of supporting various EIA-485 protocols including, but not limited to BACnet MS/TP and Modbus.
    a. Ports are capable of supporting various EIA-485 protocols including, but not limited to BACnet MS/TP and Modbus.

15. Controller shall support two (2) ports—each of gigabit speed—Ethernet (10/100/1000) ports.
    a. Ports are capable of supporting various Ethernet protocols including, but not limited to BACnet IP, FOX, and Modbus.

16. All ports shall be capable of having protocol(s) assigned to utilize the port's physical connection.

17. The controller shall have at a minimum four (4) onboard inputs, two (2) universal inputs and two (2) binary inputs.

18. Schedules
    a. Global controller modules shall provide normal seven-day scheduling, holiday scheduling and event scheduling.
    b. Each global controller shall support a minimum of 380 BACnet Schedule Objects and 380 BACnet Calendar Objects.

19. Logging Capabilities
    a. Each global controller shall log as minimum 2,000 objects at 15-minute intervals. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.
    b. Logs may be viewed both on-site or off-site using WAN or remote communication.
    c. Global controller shall periodically upload trended data to networked operator's workstation for long-term archiving if desired.
    d. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs.

20. Alarm Generation
    a. Alarms may be generated within the system for any object change of value or state (either real or calculated). This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
    b. Each alarm may be dialed out as noted elsewhere.
    c. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site using remote communications.
    d. Controller must be able to handle up to 2,000 alarm setups stored as BACnet event enrollment objects, with system destination and actions individually configurable.

B. BACnet MS/TP

1. BACnet MS/TP LAN must be software-configurable from 9.6 to 115.4Kbps
    a. Each BACnet MS/TP LAN shall support 64 BACnet devices at a minimum.
    b. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

C. BACnet IP

1. The global controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the local area network (LAN).

2. Must support interoperability on WANs and campus area networks (CANs), and function as a BACnet Broadcast Management Device (BBMD).

3. Each controller shall support at a minimum 128 BBMD entries.

4. BBMD management architecture shall support 3,000 subnets at a minimum.

5. Shall support BACnet Network Address Translation.

6. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

D. Expansion Ports

1. Controller shall support two (2) expansion ports.
   a. Combining the two on-board EIA-458 ports with fully loaded expansion ports, the controller shall support six (6) EIA-485 trunks simultaneously.

2. 2. Expansion cards that mate to the expansion ports shall include:
   a. Dual port EIA-485 card.
   b. LON network card.

E. Niagara Framework

1. Controller shall utilize the Tridium Niagara Framework.
   a. Niagara Framework shall be version 3.8 or newer.
   b. All Niagara licensing shall be stored on a removable MicroSD card for fast in-field replacement of controller.

2. The Niagara License for the controllers shall be an open license.
   a. The controller shall be programmable via Niagara Workplace programming tool.
   b. The controller shall be programmable via an Niagara embedded Workplace programming tool.

F. Power Supply

1. Input for power shall accept between 17 and 30VAC, 47 and 63Hz.

2. Optional rechargeable battery for shutdown of controller including storage of all data in flash memory.

3. On-board capacitor will ensure continuous operation of real-time clocks for minimum of 14 days.

G. Controller shall be in compliance with the following:

1. UL 916 for open energy management

2. FCC Class B

3. ROHS

4. IEC 60703

5. C-Tick Listed

H. Controller shall operate in the following environmental conditions:

1. -4 to 149 °F (-20 to 65 °C) without optional battery, or 32 to 122 °F (0 to 50 °C) with optional battery.

2. 0 to 95% relative humidity (RH), non-condensing.

2.4 CENTRAL PLANT EXPANDABLE CONTROLLERS

A. General

1. Expandable application controller shall be capable of providing control strategies for the system based on information from any or all connected inputs. The program that implements these strategies shall be completely flexible and user-definable. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site though simple download are not acceptable. Changing global strategies using firmware changes is also unacceptable. Program execution of controller shall be a minimum of once per second.
2. Programming shall be object-oriented using control program blocks. Controller shall support a minimum of 500 Analog Values and 500 Binary Values. Each and every analog and binary value shall support standard BACnet priority arrays. Programming tool shall be provided with system and shall be the same tool that is used to program the building controller. All flowcharts shall be generated and automatically downloaded to controller. No re-entry of database information shall be necessary.
3. Provide means to graphically view inputs and outputs on each program block in real-time as program is executing. This function may be performed using the operator's terminal or field computer.
4. Controller shall have adequate data storage to ensure high performance and data reliability. Battery shall retain static RAM memory and real-time clock functions for a minimum of 1.5 years (cumulative). Battery shall be a field-replaceable (non-rechargeable) lithium type. Unused battery life shall be 10 years.
5. The onboard, battery-backed real-time clock must support schedule operations and trendlogs.
6. Global control algorithms and automated control functions should execute using 32-bit processor.
7. Controller shall include both onboard 10Base-T/100Base-TX Ethernet BACnet communication over UTP and shall include BACnet IP communication. In addition, controller shall include BACnet Point-to-Point (PTP) connection port.
8. The base unit of the controller shall host up to 8 expansion modules with various I/O combinations. These inputs and outputs shall include universal 12-bit inputs, binary triac outputs, and 8-bit switch-selectable analog outputs (0–10V or 0–20mA). Inputs shall support 3K and 10K thermistors, 0–5VDC, 0–10VDC, 4–20mA, dry contacts and pulse inputs directly.
9. All outputs must have onboard Hand-Off-Auto (HOA) switches and a status indicator light. HOA switch position shall be monitored. Each analog output shall include a potentiometer for manually adjusting the output when the HOA switch is in the Hand position.
10. The position of each and every HOA switch shall be available system wide as a BACnet object. Expandable central plant controller shall provide up to 176 discreet inputs/outputs per base unit.

B. BACnet Conformance
   1. Central plant/AHU controller shall, as a minimum, support PTP, MS/TP and Ethernet BACnet LAN types. It shall communicate directly through these BACnet LANs as a native BACnet device and shall support simultaneous routing functions between all supported LAN types. Controllers shall be approved by the BTL as meeting the BACnet Advanced Application Controller requirements.
   2. Please refer to Section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All necessary tools shall be supplied for working with proprietary information.
   3. Standard BACnet object types supported shall include, as a minimum, Analog Input, Binary Input, Analog Output, Binary Output, Analog Value, Binary Value, Device, File, Group, Event Enrollment, Notification Class, Program, and Schedule object types. All necessary tools shall be supplied for working with proprietary information.
   4. The Controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must support interoperability on WANs and CANs, and function as a BBMD.

C. Schedules
   1. Each central plant/AHU controller shall support a minimum of 50 BACnet Schedule Objects.

D. Logging Capabilities
   1. Each controller shall support a minimum of 200 trendlogs. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.
   2. Controller shall periodically upload trended data to system server for long-term archiving if desired.
   3. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs.

E. Alarm Generation
   1. Alarms may be generated within the system for any object change of value or state (either real or calculated). This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
   2. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site using remote communications.
   3. Controller must be able to handle up to 200 alarm setups stored as BACnet event enrollment objects, with system destination and actions individually configurable.

2.5 FIELD CONTROLLER

A. Provide one native BACnet application controller for each piece of unitary mechanical equipment that adequately covers all objects listed in object list for unit. All controllers shall interface to global controller through MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of unit.

B. BACnet Conformance

1. Application controllers shall, as a minimum, support MS/TP BACnet LAN types. They shall communicate directly using this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as a native BACnet device. Application controllers shall be approved by the BTL as meeting the BACnet Application Specific Controller requirements and support all BACnet services necessary to provide the following BACnet functional groups:
   a. Files Functional Group
   b. Reinitialize Functional Group
   c. Device Communications Functional Group

2. Please refer to Section 22.2, BACnet Functional Groups in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

3. Standard BACnet object types supported shall include, as a minimum, Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File, and Program Object Types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

C. Application controllers shall include universal inputs with 10-bit resolution that can accept 3K and 10K thermistors, 0–5VDC, 4–20mA, dry contact signals and a minimum of 3 pulse inputs. Any input on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor. Controller shall include binary outputs on board with analog outputs as needed.

D. All program sequences shall be stored on board controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely through modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using same programming tools as global controller and as described in operator workstation section. All programming tools shall be provided and installed as part of system.

E. Application controller shall include support for intelligent room sensor (see Section 2.10.B.) Display on room sensor shall be programmable at controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.

2.6 TOUCH SCREEN COMMUNICATING THERMOSTAT

A. BACnet Conformance

1. Touch screen communicating thermostats shall be approved by the BTL as meeting the BACnet Application Specific Controller requirements.
2. Touch screen Communicating Thermostats shall, at a minimum, support MS/TP BACnet LAN types. They shall communicate directly through this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as a native BACnet device.
3. Standard BACnet object types supported shall include, as a minimum, Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File, and Program Object Types.
4. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

B. Touch screen Communicating Thermostat hardware shall:
1. Include a 32 Bit processor
2. Include a backlit touch screen for the user interface, buttons are not allowed.
3. Include Three (3) universal inputs with 12-bit resolution that can accept 3K and 10K Type II thermistors, 0-10VDC, 0–5 VDC, 4-20mA, and dry contact signals. Inputs on controller may be either analog or digital.
4. Include built-in temperature sensor.
5. Include built-in humidity sensor.
6. Include Six (6) relay outputs on board.
7. Include Two (2) analog outputs with 12-bit resolution. Each auto-detecting for 0-10 V or 4-20 mA control signals.
8. Meet the requirements of Listed Underwriters Laboratory for Open Energy Management Equipment (PAZX) under the UL Standard for Safety 916.
9. Meet the requirements of EMC Directive (European CE Mark) EN 60950.
10. Meet the requirements for FCC Part 15, Class B.
11. Be powered by 24VAC power.

2.7 AUXILIARY CONTROL DEVICES

A. Temperature Sensors

1. All temperature sensors to be solid-state electronic, interchangeable with housing appropriate for application. Wall sensors to be installed as indicated on drawings. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion sensors to be installed in wells provided by control contractor, but installed by mechanical contractor. Immersion wells shall be filled with thermal compound before installation of immersion sensors. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake, and in a location that is in the shade most of the day.

B. Intelligent Room Sensor with Touchscreen

1. Hardware
   a. Room sensor shall include:
      1) Backlit touchscreen LCD digital display
      2) Temperature sensor

3) Humidity sensor
4) Programmable Status Light indicator
5) CO2 sensor where applicable.

b. Temperature sensor shall be a Uni-Curve Type II thermistor with an accuracy of +/- 0.36 °F (0.3 °C) at calibration point over the range of 32 to 158 °F or better.
c. Humidity sensor shall have an accuracy of +/-3% from 10 to 90% relative humidity (RH) or better, non-condensing.
d. The intelligent room sensor's Status Light indicator shall have a minimum of four (4) colors (blue, red, amber and green) that will cast a glow onto the wall below the sensor to be used as visual indicator to the occupants of the condition of the system. The color and on/off state of the Status Light indicator shall be fully programmable.
e. CO2 sensor shall have an accuracy of +/- 30 ppm over the range of 0–5000 ppm or better.
f. CO2 sensor shall utilize Automatic Baseline Correction to maintain sensor calibration without the need for manual calibration.
g. The user shall interact with the smart sensor using a touchscreen, with no buttons allowed.
h. The intelligent room sensor shall have provisions for a tamper proof installation requiring tools to be removed from the wall.
i. The touchscreen shall have a surface hardness of Mohs 7 or greater to prevent being easily scratched.
j. Controller shall function as room control unit, and allow occupant to raise and lower setpoint, and activate terminal unit for override use—all within limits as programmed by building operator.

2. Display Content
a. The intelligent room sensor shall simultaneously display room setpoint, room temperature, and outside temperature at each controller.
b. The intelligent room sensor shall have the ability to add or remove from the display time-of-day, room humidity, and indoor air temperature to customize the view for the customer.
c. The intelligent room sensor must have the capability to show temperatures in degrees Fahrenheit or degrees Celsius.
d. A communication loss or improper communications wiring shall be displayed on the LCD screen to aid in trouble shooting.
e. Information about the version of firmware shall be displayable on the LCD screen.
f. A cleaning mode will be provided to allow for the touchscreen to be cleaned without inadvertently making changes to system parameters.
g. The intelligent room sensor shall have the ability to display the status of a lighting zone and control the on/off state of the zone from the touchscreen using a tenant-accessible display page.
h. The intelligent room sensor shall have the ability to display the status of a window zone (e.g., blinds) and control the on/off state of the zone from the touchscreen using a tenant-accessible display page.
i. After Hours Override shall:
1) Override time may be set and viewed in 30-minute increments.
2) Override time countdown shall be automatic, but may be reset to zero by occupant from the sensor.
3) Time remaining shall be displayed.

4) Display shall show the word "OFF" in unoccupied mode unless a function button is pressed.

3. Other Modes
   a. The intelligent room sensor shall also allow service technician access to hidden functions for advanced system configuration. This functionality shall be accessed-protected with a configurable PIN number.
   b. Field Service Mode shall allow access to common parameters as dictated by the application's sequence of operations. The parameters shall be viewed and set from the intelligent room sensor with no computer or other field service tool needed.
   c. If the intelligent room sensor is connected to VAV controller, Balance Mode shall allow a VAV box to be balanced and all air flow parameters viewed. The balancing parameters shall be viewed and set from the intelligent room sensor with no computer or other field service tool needed.

4. Intelligent Room Sensor shall be in compliance of the following:
   a. UL Standard for Safety 916
   b. FCC Part 15.107 & 109, Class B, CFR47-15

C. Room Sensor without display

1. Fully BACnet-compliant wall sensor with industrial-grade thermistor and push button on cover for after-hours activation

2. Setpoint adjustment lever for occupant setpoint adjustment range. Level shall be removal.

3. Accuracy: 0.36 ˚F over 32 ˚F to 158 ˚F range

4. Resistance: 10K ohm at 77 ˚F

5. Stability: 0.036 ˚F drift per year**.**

D. Stainless Steel Room Sensor

1. Stainless steel wall module shall have a thermistor temperature sensor under a cover/enclosure designed for mounting on a standard electrical switch box.

2. Accuracy: 0.36 ˚F over 32 ˚F to 158 ˚F range

3. Resistance: 10K ohm at 77 ˚F

4. Stability: 0.036 ˚F drift per year**.**

E. Differential Pressure Sensors

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

   a. Veris Industries
   b. Honeywell
   c. RIB, Inc.
   d. Kele

2. Sensor shall have field selectable outputs of 0-5 VDC, 0-10 VDC, and 4-20 mA

3. Where specified, sensor shall have and LCD display that displays measured value.

4. Sensor accuracy shall be plus or minus 1% FS selected range.

F. Ductwork Mounted and Outside Air Humidity Sensor.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

   a. Alerton
   b. Honeywell
   c. Johnson Controls

2. Humidity transducer shall be accurate to +/- 3% between 20-95% RH NIST traceable calibration.

3. Sensors shall have a field selectable output of 0-10 Vdc, 0-5 Vdc, or 4-20 mA.

4. Outside air sensors shall include an integral sun shield.

5. Duct sensors shall have sensor approximately in center of the duct, and shall have selectable lengths of 6, 12, and 18 inches.

G. Duct Mount, Pipe Mount, and Outside Air Temperature Sensor:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

   a. ACI
   b. Honeywell
   c. Johnson Controls
   d. Kele

2. Outside air sensors shall include an integral sun shield.

3. Temperature sensors shall have an accuracy of plus or minus 1.0 deg. F. over operating range.

4. Duct sensors shall have sensor approximately in center of the duct, and shall have selectable lengths of 6, 12, and 18 inches.

5. Multipoint averaging element sensors shall be provided where specified, and shall have a minimum of one foot of sensor length for each square foot of duct area (provide multiple sensors if necessary).

6. Pipe mount sensors shall have copper, or stainless steel separable wells.

H. Current Sensors

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

   a. Honeywell
   b. RIB, Inc.
   c. Veris Industries
   d. Kele

2. Scale sensors so that average operating current is between 20-80% full scale.

3. Accuracy plus or minus 1.0% (5-100% full scale)

4. Operating frequency 50-600 Hz.

5. Operating Temperature 5-104 deg. F (-15 – 40 deg. C), Operating Humidity 0-95% non-condensing

6. Approvals CE, UL.

2.8 ELECTRONIC ACTUATORS AND VALVES

A. Quality Assurance for Actuators and Valves

1. UL Listed Standard 873 and C.S.A. Class 4813 02 certified.

2. NEMA 2, NEMA 4 and NEMA 4X rated enclosures, provide with weather shield for outside mounting. Refer to room classification for NEMA requirements.

3. Five-year manufacturer's warranty. Two-year unconditional and three-year product defect from date of installation.

B. Execution Details for Actuators and Valves

1. The DDC System Provider (BAS contractor) shall furnish all specified motorized control valves and actuators. DDC System Provider shall furnish all control wiring to actuators. The plumbing or mechanical contractor shall install all valves. Equal percentage control characteristic shall be provided for all water coil control valves. Linear valve characteristic is acceptable for 3-way valves that are 2.5 inches and above.

2. CV values less than 5 shall be on/off or floating type or analog (2–10VDC, 4–20mA).

3. CV values greater than 5 analog (2–10VDC, 4–20mA).

C. Actuators for damper and control valves 0.5–6 inches shall be electric, provide actuators as follows:

1. UL Listed Standard 873 certify actuators.

2. Position indicator device shall be installed and made visible to the exposed side of the actuator. For damper short shaft mounting, a separate indicator shall be provided to the exposed side of the actuator.

3. Overload Protection: Actuators shall provide protection against actuator burnout by using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation are acceptable only for butterfly valve actuators.

4. A Pushbutton gearbox release shall be provided for all non-spring actuators.

5. Modulating actuators shall be 24VAC and consume 10VA power or less.

D. Damper Actuators:

1. Outside air and exhaust air damper actuators shall be mechanical spring return. Capacitors or other non-mechanical forms of fail-safe are not acceptable. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.

2. Economizer actuators shall utilize analog control 2–10VDC, floating control is not acceptable.

3. Electric damper actuators shall be direct shaft-mounted and use a V-bolt and toothed V-clamp causing a cold weld effect for positive gripping. Single bolt or set-screw type fasteners are not acceptable.

4. One electronic actuator shall be direct shaft-mounted per damper section. No connecting rods or jackshafts shall be needed. Small outside air and return air economizer dampers may be mechanically linked together if one actuator has sufficient torque to drive both and damper drive shafts are both horizontal installed.

5. Multi-section dampers with electric actuators shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft-mounted per damper section. (See below execution section for more installation details.)

E. Control Dampers.

1. The DDC System Provider (BAS contractor) shall furnish all automatic control dampers unless provided with packaged equipment. BAS contractor shall furnish all control wiring to actuators. The sheet metal contractor shall install all dampers unless provided with packaged equipment.

2. All dampers used for modulating service shall be opposed blade type and arranged for normally open or normally closed operation as required. The damper is to be sized so that, when wide open, the pressure drop is a sufficient amount of its close-off pressure drop for effective throttling.

3. All dampers used for two-position or open-close control shall be parallel blade type arranged for normally open or closed operation as required.

4. Damper linkage hardware shall be constructed of aluminum or corrosion-resistant zinc and nickel-plated steel and furnished as follows:

5. Bearing support bracket and drive blade pin extension shall be provided for each damper section. Sheet metal contractor shall install bearing support bracket and drive blade pin extension. Sheet metal contractor shall provide permanent indication of blade position by scratching or marking the visible end of the drive blade pin extension.

6. Drive pin may be round only if V-bolt and toothed V-clamp is used to cause a cold weld effect for positive gripping. For single bolt or set-screw type actuator fasteners, round damper pin shafts must be milled with at least one side flat to avoid slippage.

7. Damper manufacturer shall supply alignment plates for all multi-section dampers.

F. Control Valves

1. The DDC System Provider (BAS contractor) shall furnish all specified motorized control valves and actuators. BAS contractor shall furnish all control wiring to actuators. The plumbing or mechanical contractor shall install all valves. Equal percentage control characteristic shall be provided for all water coil control valves. Linear valve characteristic is acceptable for 3-way valves that are 2.5 inches and above.

2. Water Valves 0.5–0.75 inches:

   a. Service: Chilled water, hot water, up to 60% glycol, 2-way or 3-way application
   b. General Description: Ball valve operated by a rotary actuator.
   c. Actuator Description: 24 VAC/DC, 75 seconds run time,
   d. Fail safe for all heating applications with 60 seconds minimum run time.
   e. Media temperature range: 36 ̊F to 212 ̊F
   f. Body pressure rating: 360 psi
   g. Close-off is 75psi,
   h. Maximum differential is 40psi
   i. Body: forged brass
   j. Ball Chrome plate brass
   k. Stem: Brass
   l. Seat: Teflon
   m. O-ring: lubricated EPDM

3. Water Valves 0.5–2.5 inches:

   a. Service: Chilled water, hot water, up to 60% glycol, 2-way or 3-way application
   b. General Description: Characterized ball valve operated by a rotary actuator.
   c. Actuator Description: 24 VAC/DC, 95 seconds run time,
   d. Spring return for all heating applications with 25 seconds minimum run time.
   e. Media temperature range: 36 ̊F to 212 ̊F
   f. Body pressure rating: 600 psi
   g. Close-off is 200 psi,
   h. Maximum differential is 50 psi
   i. Body: forged brass, nickel plated
   j. Ball Stainless steel
   k. Stem: Stainless steel
   l. Seat: Teflon

m. O-ring: lubricated EPDM
n. Characterized disc: TEFZEL

4. Water Valves greater than 3 inches for 150 psi ASME/ANSI:

a. Service: Chilled water, hot water, up to 60% glycol, 2-way or 3-way application
b. General Description: High Performance Butterfly valve with ASME/ANSI Class 150 end fittings.
c. Spring return for all heating applications with 25 seconds minimum run time.
d. Media temperature range: 36 ̊F to 400 ̊F
e. Body pressure rating: 150 psi
f. Close-off is 285 psi,
g. Body: carbon steel full lug
h. Disc: 316 Stainless steel
i. Shaft: 17-4 PH stainless
j. Seat: RTFE
k. Gland seal: TFE
l. Bearings: glass backed PTFE

5. Water Valves 3 inches and greater for 300 psi ASME/ANSI:

a. Service: Chilled water, hot water, up to 60% glycol, 2-way or 3-way application
b. General Description: High Performance Butterfly valve with ASME/ANSI Class 300 end fittings.
c. Spring return for all heating applications with 35 seconds minimum run time.
d. Media temperature range: 36 ̊F to 400 ̊F
e. Body pressure rating: 300 psi
f. Close-off is 600 psi,
g. Body: carbon steel full lug
h. Disc: 316 Stainless steel
i. Shaft: 17-4 PH stainless
j. Seat: RTFE
k. Gland seal: TFE
l. Bearings: glass backed PTFE

6. Steam valves up to 6 inches and 35 psi inlet pressure:

a. General Description: Equal percentage global valve.
b. Spring return for all air handling applications heating applications with 25 seconds minimum run time.
c. Maximum inlet pressure rating: 35 psi
d. Maximum differential pressure rating: 20 psi
e. Body: bronze
f. Stem: Stainless Steel
g. Plug: Stainless Steel
h. Seat: Stainless Steel
i. Stem packing: Spring loaded TFE
j. Disc/ Seal: EPDM

G. Performance Verification Test

1. Control loops shall cause productive actuation with each movement of the actuator and actuators shall modulate at a rate that is stable and responsive. Actuator movement shall not occur before the effects of previous movement have affected the sensor.

2. Actuator shall have capability of signaling a trouble alarm when the actuator Stop-Go Ratio exceeds 30%.

H. Actuator mounting for damper and valve arrangements shall comply to the following:

1. Damper actuators: Shall not be installed in the air stream

2. A weather shield shall be used if actuators are located outside. For damper actuators, use clear plastic enclosure.

3. Damper or valve actuator ambient temperature shall not exceed 122 degrees F through any combination of medium temperature or surrounding air. Appropriate air gaps, thermal isolation washers or spacers, standoff legs, or insulation shall be provided as necessary.

4. Actuator cords or conduit shall incorporate a drip leg if condensation is possible. Water shall not be allowed to contact actuator or internal parts. Location of conduits in temperatures dropping below dew point shall be avoided to prevent water from condensing in conduit and running into actuator.

5. Damper mounting arrangements shall comply to the following:

   a. The ventilation subcontractor shall furnish and install damper channel supports and sheet metal collars.
   b. No jack shafting of damper sections shall be allowed.
   c. Multi-section dampers shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per section.

6. Multiple section dampers of two or more shall be arranged to allow actuators to be direct shaft mounted on the outside of the duct.

7. Multiple section dampers of three or more sections wide shall be arranged with a 3-sided vertical channel (8 inches wide by 6 inches deep) within the duct or fan housing and between adjacent damper sections. Vertical channel shall be anchored at the top and bottom to the fan housing or building structure for support. The sides of each damper frame shall be connected to the channels. Holes in the channel shall allow damper drive blade shafts to pass through channel for direct shaft-mounting of actuators. Open side of channel shall be faced downstream of the airflow, except for exhaust air dampers.

8. Multiple section dampers to be mounted flush within a wall or housing opening shall receive either vertical channel supports as described above or sheet metal standout collars. Sheet metal collars (12-inch minimum) shall bring each damper section out of the wall to allow direct shaft-mounting of the actuator on the side of the collar.

2.9 ENCLOSURES

A. All controllers, power supplies and relays shall be mounted in enclosures.

B. Refer to contract documents for NEMA classification requirements.

C. Enclosures shall have hinged door

2.10 CONTROL WIRING AND RACEWAYS

A. Comply with requirements in Division 16 Section "Low-Voltage Electrical Power Conductors and Cables" electrical power conductors and cables.

B. Comply with requirements in Division 16 Section "Raceways and Boxes for Electrical Systems" for electrical power raceways and boxes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.

B. Notify the owner's representative in writing of conditions detrimental to the proper and timely completion of the work.

C. Do not begin work until all unsatisfactory conditions are resolved.

3.2 FIELD CONTROLLER INSTALLATION

A. All unit ventilation Alerton field controllers will be sent to Daikin Unit Ventilator Factory for factory mounting.

3.3 LOCATION AND INSTALLATION OF COMPONENTS

A. Locate and install components for easy accessibility; in general, mount 48 inches above floor with minimum 3 feet of clear access space in front of units. Obtain approval on locations from owner's representative prior to installation.

B. All instruments, switches, transmitters, etc., shall be suitably wired and mounted to protect them from vibration, moisture, and high or low temperatures.

C. Identify all equipment and panels. Provide permanently mounted tags for all panels.

D. Provide stainless steel or brass thermowells suitable for respective application and for installation under other sections, and sized to suit pipe diameter without restricting flow.

3.4 INTERLOCKING AND CONTROL WIRING

A. Provide all interlock and control wiring. All wiring shall be installed neatly and professionally, in accordance with Specification Division 26 and all national, state and local electrical codes.

B. Provide wiring as required by functions as specified and as recommended by equipment manufacturers, to serve specified control functions. Provide shielded low capacitance wire for all communications trunks.

C. Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required. Coordinate location and arrangement of all control equipment with the owner's representative prior to rough-in.

D. Provide auxiliary pilot duty relays on motor starters as required for control function.

E. All control wiring in the utility room (mechanical, electrical, telephone and boiler rooms) and in wall to be installed in conduit. All wiring to be installed neatly and inconspicuously per local code requirements. If local code and the contract documents allows, control wiring above accessible ceiling spaces may be run with plenum-rated cable (without conduit).

3.5 DDC OBJECT TYPE SUMMARY

A. Provide all database generation.

B. Displays
   1. System displays shall show all analog and binary object types within the system. They shall be logically laid out for easy use by the owner. Provide outside air temperature indication on all system displays associated with economizer cycles.

C. Run Time Totalization
   1. At a minimum, run time totalization shall be incorporated for each monitored major airflow fans and water flows. Warning limits for each point shall be entered for alarm and or maintenance purposes.

D. Trendlog
   1. All binary and analog object types (including zones) shall have the capability to be automatically trended.

E. Alarm
   1. All analog inputs (High/Low Limits) and selected binary input alarm points shall be prioritized and routed (locally or remotely) with alarm message per owner's requirements.

F. Database Save
   1. Provide backup database for all standalone application controllers on disk.

3.6 FIELD SERVICES

A. Prepare and start logic control system under provisions of this section.

B. Start up and commission systems. Allow sufficient time for startup and commissioning prior to placing control systems in permanent operation.

C. Provide the capability for off-site monitoring at control contractor's local or main office. At a minimum, off-site facility shall be capable of system diagnostics and software download. Owner shall provide phone line for this service for one year or as specified.

3.7 DDC SYSTEM INTERFACE WITH EXISITNG TOWN WIDE SERVER.

A. Provide a building automation system to control the system as defined for the project and to allow all objects as defined by ASHRAE Standard SPC-135A/95 to be sent to the existing Town Wide server.

B. The project's graphics and software must be programmed into the existing BACnet server and must utilize identical programming and graphic software as already exists.

3.8 CONTROL DEVICES FOR INSTALLATION BY INSTALLERS

A. Deliver selected control devices, specified in indicated HVAC instrumentation and control device Sections, to identified equipment and systems manufacturers for factory installation and to identified installers for field installation.

3.9 GENERAL INSTALLATION REQUIREMENTS

A. Install products to satisfy more stringent of all requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Support products, piping wiring and raceways. Brace products to prevent lateral movement and sway or a break in attachment when subjected to a force.

D. If codes and referenced standards are more stringent than requirements indicated, comply with requirements in codes and referenced standards.

E. Fabricate openings and install sleeves in ceilings, floors, roof, and walls required by installation of products. Before proceeding with drilling, punching, and cutting, check for concealed work to avoid damage. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

F. Firestop penetrations made in fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

G. Seal penetrations made in acoustically rated assemblies. Comply with requirements in Division 07 Section "Joint Sealants."

H. Fastening Hardware:

1. Stillson wrenches, pliers, and other tools that damage surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening fasteners.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts and screws with graphite and oil before assembly.

I. If product locations are not indicated, install products in locations that are accessible and that will permit service and maintenance from floor, equipment platforms, or catwalks without removal of permanently installed furniture and equipment.

J. Corrosive Environments:

1. Avoid or limit use of materials in corrosive airstreams and environments, including, but not limited to, the following:

   a. Laboratory exhaust-air streams.
   b. Process exhaust-air streams.

2. When conduit is in contact with a corrosive airstream and environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment. Comply with requirements for installation of raceways and boxes specified in Division 16 Section "Raceways and Boxes for Electrical Systems."
3. Where instruments are located in a corrosive airstream and are not corrosive resistant from manufacturer, field install products in NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.10 OPERATOR WORKSTATION INSTALLATION

A. Desktop Operator Workstations Installation:

1. Install operator workstation at location directed by Owner.
2. Install multiple-receptacle power strip with cord for use in connecting multiple workstation components to a single duplex electrical power receptacle.
3. Install software on server and verify software functions properly.
4. Develop Project-specific graphics, trends, reports, logs and historical database.
5. Power workstation through a UPS unit. Locate UPS adjacent to workstation.

B. Color Graphics Application:
1. Develop Project-specific library of symbols for representing system equipment and products.
2. Incorporate digital images of Project-completed installation into graphics where beneficial to enhance effect.
3. Refine graphics as necessary for Owner acceptance.
4. On receiving Owner acceptance, print a hard copy for inclusion in operation and maintenance manual. Prepare a scanned copy PDF file of each graphic and include with softcopy of DDC system operation and maintenance manual.

3.11 GATEWAY INSTALLATION

A. Install gateways if required for DDC system communication interface requirements indicated.

1. Install gateway required to suit indicated requirements.

B. Test gateway to verify that communication interface functions properly.

3.12 ROUTER INSTALLATION

A. Install routers if required for DDC system communication interface requirements indicated.

1. Install router(s) required to suit indicated requirements.

B. Test router to verify that communication interface functions properly.

3.13 CONTROLLER INSTALLATION

A. Install controllers in enclosures to comply with indicated requirements.

B. Connect controllers to field power supply**.**

C. Install controller with latest version of applicable software and configure to execute requirements indicated.

D. Test and adjust controllers to verify operation of connected I/O to achieve performance indicated requirements while executing sequences of operation.

E. Installation Controllers:

1. Quantity and location of controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
2. Install controllers in a protected location that is easily accessible by operators.
3. Top of controller shall be within 72 inches of finished floor.
4. For controllers not mounted directly on equipment being controlled, install controllers in a protected location that is easily accessible by operators.

3.14 ENCLOSURES INSTALLATION

A. Install the following items in enclosures, to comply with indicated requirements:

1. Gateways.
2. Routers.
3. Controllers.
4. Electrical power devices.
5. UPS units.
6. Relays.
7. Accessories.

8. Instruments.
9. Actuators

B. Attach wall-mounted enclosures to wall using the following types of steel struts:

1. For NEMA 250, Type 1 Enclosures: Use painted steel, galvanized-steel, or corrosion-resistant-coated steel strut and hardware.
2. For NEMA 250, Type 4 or Type 4X Enclosures and Enclosures Located Outdoors: Use stainless-steel strut and hardware.

C. Align top or bottom of adjacent enclosures of like size.

D. Install floor-mounted enclosures located in mechanical equipment rooms on concrete housekeeping pads. Attach enclosure legs using galvanized- or stainless-steel anchors.

E. Install continuous and fully accessible wireways to connect conduit, wire, and cable to multiple adjacent enclosures. Wireway used for application shall have protection equal to NEMA 250 rating of connected enclosures.

3.15 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections.

3.16 DDC SYSTEM I/O CHECKOUT PROCEDURES

A. Check installed products before continuity tests, leak tests and calibration.

B. Check instruments for proper location and accessibility.

C. Check instruments for proper installation on direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.

D. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material and support.

E. Control Damper Checkout:

1. Verify that control dampers are installed correctly for flow direction.
2. Verify that proper blade alignment, either parallel or opposed, has been provided.
3. Verify that damper frame attachment is properly secured and sealed.
4. Verify that damper actuator and linkage attachment is secure.
5. Verify that actuator wiring is complete, enclosed and connected to correct power source.
6. Verify that damper blade travel is unobstructed.

F. Control Valve Checkout:

1. Verify that control valves are installed correctly for flow direction.
2. Verify that valve body attachment is properly secured and sealed.

3. Verify that valve actuator and linkage attachment is secure.
4. Verify that actuator wiring is complete, enclosed and connected to correct power source.
5. Verify that valve ball, disc or plug travel is unobstructed.
6. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

G. Instrument Checkout:

1. Verify that instrument is correctly installed for location, orientation, direction and operating clearances.
2. Verify that attachment is properly secured and sealed.
3. Verify that conduit connections are properly secured and sealed.
4. Verify that wiring is properly labeled with unique identification, correct type and size and is securely attached to proper terminals.
5. Inspect instrument tag against approved submittal.
6. For instruments with tubing connections, verify that tubing attachment is secure and isolation valves have been provided.
7. For flow instruments, verify that recommended upstream and downstream distances have been maintained.
8. For temperature instruments:

    a. Verify sensing element type and proper material.
    b. Verify length and insertion.

3.17 DEMONSTRATION

A. Engage a factory-authorized service representative with complete knowledge of Project-specific system installed to train Owner's maintenance personnel to adjust, operate, and maintain DDC system.

B. Extent of Training:

1. Base extent of training on scope and complexity of DDC system indicated and training requirements indicated. Provide extent of training required to satisfy requirements indicated even if more than minimum training requirements are indicated.
2. Inform Owner of anticipated training requirements if more than minimum training requirements are indicated.
3. Minimum Training Requirements:

    a. Provide not less than 1 days of training total.
    b. Stagger training over multiple training classes to accommodate Owner's requirements. All training shall occur before end of warranty period.
    c. Total days of training shall be broken into not more than four separate training classes.

C. Video of Training Sessions:

1. Provide a digital video and audio recording of each training session. Create a separate recording file for each session.
2. Stamp each recording file with training session number, session name and date.
3. Provide Owner with two copies of digital files on DVDs or flash drives for later reference and for use in future training.
4. Owner retains right to make additional copies for intended training purposes without having to pay royalties.

END OF SECTION 23 09 00

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General Provisions of the Contract, including General and Supplementary Conditions and Division 1, General Requirements, apply to the work specified in this Section.

B. The General Requirements in Section 20 00 50 shall also govern the work under this Section.

1.2 QUALIFICATIONS OF THE HVAC SYSTEM CLEANING CONTRACTOR

A. Membership: The HVAC system cleaning contractor shall be a certified member of the National Air Duct Cleaners Association (NADCA), or shall maintain membership in a nationally recognized non-profit industry organization dedicated to the cleaning of HVAC systems.

B. Certification: The HVAC system cleaning contractor shall have a minimum of one (1) Air System Cleaning Specialist (ASCS) certified by NADCA on a full time basis, or shall have staff certified by a nationally recognized certification program and organization dedicated to the cleaning of HVAC systems.

C. Supervisor Qualifications: A person certified as an ASCS by NADCA, or maintaining an equivalent certification by a nationally recognized program and organization, shall be responsible for the total work herein specified.

D. Experience: The HVAC system cleaning contractor shall submit records of experience in the field of HVAC system cleaning as requested by the **Owner**. Bids shall only be considered from firms which are regularly engaged in HVAC system maintenance with an emphasis on HVAC system cleaning and decontamination.

E. Equipment, Materials and Labor: The HVAC system cleaning contractor shall possess and furnish all necessary equipment, materials and labor to adequately perform the specified services.

1. The contractor shall assure that its employees have received safety equipment training, medical surveillance programs, individual health protection measures, and manufacturer's product and material safety data sheets (MSDS) as required for the work by the U.S. Occupational Safety and Health Administration, and as described by this specification. For work performed in countries outside of the U.S.A., contractors should comply with applicable national safety codes and standards.

2. The contractor shall maintain a copy of all current MSDS documentation and safety certifications at the site at all times, as well as comply with all other site documentation requirements of applicable OSHA programs and this specification

3. Contractor shall submit to the **Owner** all Material Safety Data Sheets (MSDS) for all chemical products proposed to be used in the cleaning process.

F. Licensing: The HVAC system cleaning contractor shall provide proof of maintaining the proper license(s), if any, as required to do work in this state. Contractor shall comply with all Federal, state and local rules, regulations, and licensing requirements.

1.3 STANDARDS

A. NADCA Standards: The HVAC system cleaning contractor shall perform the services specified here in accordance with the current published standards of the National Air Duct Cleaners Association (NADCA).

1. All terms in this specification shall have their meaning defined as stated in the NADCA Standards.

2. NADCA Standards must be followed with no modifications or deviations being allowed.

1.4 DOCUMENTS

A. Mechanical Drawings: The **Owner** shall provide the HVAC system cleaning contractor with one copy of the following documents:

1. Project drawings and specifications.

2. Approved construction revisions pertaining to the HVAC system.

3. Any existing indoor air quality (IAQ) assessments or environmental reports prepared for the facility.

PART 2 – HVAC SYSTEM CLENING SPECIFICATIONS AND REQUIREMENTS.

2.1 SCOPE OF WORK

A. Scope: This section defines the ***minimum*** requirements necessary to render HVAC components clean, and to verify the cleanliness through inspection and/or testing in accordance with items specified herein and applicable NADCA Standards.

The Contractor shall be responsible for the removal of visible surface contaminants and deposits from within the HVAC system in strict accordance with these specifications.

The HVAC system includes any interior surface of the facility's air distribution system for conditioned spaces and/or occupied zones. This includes the entire heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system. The return air grilles, return air ducts to the air handling unit (AHU), the interior surfaces of the AHU, mixing box, coil compartment, condensate drain pans, humidifiers and dehumidifiers, supply air ducts, fans, fan housing, fan blades, air wash systems, spray eliminators, turning vanes, filters, filter housings, reheat coils, and supply diffusers are all considered part of the HVAC system. The HVAC system may also include other components such as dedicated exhaust and ventilation components and make-up air systems.

2.2 HVAC SYSTEM COMPONENT INSPECTIONS AND SITE PREPARATION

A. HVAC System Component Inspections: Prior to the commencement of any cleaning work, the HVAC system cleaning contractor shall perform a visual inspection of the HVAC system to determine appropriate methods, tools, and equipment required to satisfactorily complete this project. The cleanliness inspection should include air handling units and representative areas of the HVAC system components and ductwork. In HVAC systems that include multiple air handling units, a representative sample of the units should be inspected.

The cleanliness inspection shall be conducted without negatively impacting the indoor environment through excessive disruption of settled dust, microbial amplification or other debris. In cases where contamination is suspected, and/or in sensitive environments where even small amounts of contaminant may be of concern, environmental engineering control measures should be implemented

1. Damaged system components found during the inspection shall be documented and brought to the attention of the **Owner**.

B. Site Evaluation and Preparations: Contractor shall conduct a site evaluation, and establish a specific, coordinated plan which details how each area of the building will be protected during the various phases of the project.

C. Inspector Qualifications: Qualified personnel should perform the HVAC cleanliness inspection to determine the need for cleaning. At minimum, such personnel should have an understanding of HVAC system design, and experience in utilizing accepted indoor environmental sampling practices, current industry HVAC cleaning procedures, and applicable industry standards.

2.3 GENERAL HVAC SYSTEM CLEANING REQUIREMENTS

A. Containment: Debris removed during cleaning shall be collected and precautions must be taken to ensure that Debris is not otherwise dispersed outside the HVAC system during the cleaning process.

B. Particulate Collection: Where the Particulate Collection Equipment is exhausting inside the building, HEPA filtration with 99.97% collection efficiency for 0.3-micron size (or greater) particles shall be used. When the Particulate Collection Equipment is exhausting outside the building, Mechanical Cleaning operations shall be undertaken only with Particulate Collection Equipment in place, including adequate filtration to contain Debris removed from the HVAC system. When the Particulate Collection Equipment is exhausting outside the building, precautions shall be taken to locate the equipment down wind and away from all air intakes and other points of entry into the building.

C. Controlling Odors: Measures shall be employed to control odors and/or mist vapors during the cleaning process.

D. Component Cleaning: Cleaning methods shall be employed such that all HVAC system components must be Visibly Clean as defined in applicable standards (see NADCA

Standards). Upon completion, all components must be returned to those settings recorded just prior to cleaning operations.

E. Air-Volume Control Devices: Dampers and any air-directional mechanical devices inside the HVAC system must have their position marked prior to cleaning and, upon completion, must be restored to their marked position.

F. Service Openings: The contractor shall utilize service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry, and inspection.

1. Contractor shall utilize the existing service openings already installed in the HVAC system where possible.
2. Other openings shall be created where needed and they must be created so they can be sealed in accordance with industry codes and standards.
3. Closures must not significantly hinder, restrict, or alter the airflow within the system.
4. Closures must be properly insulated to prevent heat loss/gain or condensation on surfaces within the system.
5. Openings must not compromise the structural integrity of the system.
6. Construction techniques used in the creation of openings should conform to requirements of applicable building and fire codes, and applicable NFPA, SMACNA and NADCA Standards.
7. Cutting service openings into flexible duct is not permitted. Flexible duct shall be disconnected at the ends as needed for proper cleaning and inspection.
8. Rigid fiber glass duct systems shall be resealed in accordance with NAIMA recommended practices. Only closure techniques that comply with UL Standard 181 or UL Standard 181a are suitable for fiber glass duct system closures.
9. All service openings capable of being re-opened for future inspection or remediation shall be clearly marked and shall have their location reported to the **Owner** in project report documents.

G. Ceiling sections (tile): The contractor may remove and reinstall ceiling sections to gain access to HVAC systems during the cleaning process.

H. Air distribution devices (registers, grilles & diffusers): The contractor shall clean all air distribution devices.

I. Air handling units, terminal units (VAV, Dual duct boxes, etc.), blowers and exhaust fans: The contractor shall insure that supply, return, and exhaust fans and blowers are thoroughly cleaned. Areas to be cleaned include blowers, fan housings, plenums (except ceiling supply and return plenums), scrolls, blades, or vanes, shafts, baffles, dampers and drive assemblies. All visible surface contamination deposits shall be removed in accordance with NADCA Standards. Contractor shall:

1. Clean all air handling units (AHU) internal surfaces, components and condensate collectors and drains.
2. Assure that a suitable operative drainage system is in place prior to beginning wash down procedures.
3. Clean all coils and related components, including evaporator fins.

J. Contractor shall:

1. Create service openings in the system as necessary in order to accommodate cleaning of otherwise inaccessible areas.
2. Mechanically clean all duct systems to remove all visible contaminants, such that the systems are capable of passing Cleaning Verification Tests (see NADCA Standards).

2.4 HEALTH AND SAFETY

A. Safety Standards: Cleaning contractors shall comply with applicable federal, state, and local requirements for protecting the safety of the contractor's employees, building occupants, and the environment. In particular, all applicable standards of the Occupational Safety and Health Administration (OSHA) shall be followed when working in accordance with this specification.

B. Occupant Safety: No processes or materials shall be employed in such a manner that they will introduce additional hazards into occupied spaces.

C. Disposal of Debris: All Debris removed from the HVAC System shall be disposed of in accordance with applicable federal, state and local requirements.

2.5 MECHANICAL CLEANING METHODOLOGY

A. Source Removal Cleaning Methods: The HVAC system shall be cleaned using Source Removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and safely remove contaminants from the facility. It is the contractor's responsibility to select Source Removal methods that will render the HVAC system Visibly Clean and capable of passing cleaning verification methods (See applicable NADCA Standards) and other specified tests, in accordance with all general requirements. No cleaning method, or combination of methods, shall be used which could potentially damage components of the HVAC system or negatively alter the integrity of the system.

1. All methods used shall incorporate the use of vacuum collection devices that are operated continuously during cleaning. A vacuum device shall be connected to the downstream end of the section being cleaned through a predetermined opening. The vacuum collection device must be of sufficient power to render all areas being cleaned under negative pressure, such that containment of debris and the protection of the indoor environment are assured.
2. All vacuum devices exhausting air inside the building shall be equipped with HEPA filters (minimum efficiency), including hand-held vacuums and wet-vacuums.
3. All vacuum devices exhausting air outside the facility shall be equipped with Particulate Collection including adequate filtration to contain Debris removed from the HVAC system. Such devices shall exhaust in a manner that will not allow contaminants to re-enter the facility. Release of debris outdoors must not violate any outdoor environmental standards, codes or regulations.
4. All methods require mechanical agitation devices to dislodge debris adhered to interior HVAC system surfaces, such that debris may be safely conveyed to vacuum collection devices. Acceptable methods will include those, which will not potentially

damage the integrity of the ductwork, nor damage porous surface materials such as liners inside the ductwork or system components.

B. Methods of Cleaning Fibrous Glass Insulated Components

1. Fibrous glass thermal or acoustical insulation elements present in any equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment, while the HVAC system is under constant negative pressure, and not permitted to get wet in accordance with applicable NADCA and NAIMA standards and recommendations.
2. Cleaning methods used shall not cause damage to fibrous glass components and will render the system capable of passing Cleaning Verification Tests (see NADCA Standards).

C. Damaged Fibrous Glass Material

1. Evidence of damage: If there is any evidence of damage, deterioration, delaminating, friable material, mold or fungus growth, or moisture such that fibrous glass materials cannot be restored by cleaning or resurfacing with an acceptable insulation repair coating, they shall be identified for replacement.
2. Replacement: When requested or specified, Contractor must be capable of remediating exposed damaged insulation in air handlers and/or ductwork requiring replacement.
3. Replacement material: In the event fiber glass materials must be replaced, all materials shall conform to applicable industry codes and standards, including those of UL and SMACNA. Replacement of damaged insulation is **not** covered by this specification.

D. Cleaning of coils

1. Any cleaning method may be used which will render the Coil Visibly Clean and capable of passing Coil Cleaning Verification (see applicable NADCA Standards). Coil drain pans shall be subject to Non-Porous Surfaces Cleaning Verification. The drain for the condensate drain pan shall be operational. Cleaning methods shall not cause any appreciable damage to, displacement of, inhibit heat transfer, or erosion of the coil surface or fins, and shall conform to coil manufacturer recommendations when available. Coils shall be thoroughly rinsed with clean water to remove any latent residues.

E. Antimicrobial Agents and Coatings

1. Antimicrobial agents shall only be applied if active fungal growth is reasonably suspected, or where unacceptable levels of fungal contamination have been verified through testing.
2. Application of any antimicrobial agents used to control the growth of fungal or bacteriological contaminants shall be performed after the removal of surface deposits and debris.
3. When used, antimicrobial treatments and coatings shall be applied in strict accordance with the manufacturer's written recommendations and EPA registration listing.
4. Antimicrobial coatings shall be applied according to the manufacturer's written instructions. Coatings shall be sprayed directly onto interior ductwork surfaces, rather than "fogged" downstream onto surfaces.

2.6 CLEANLINESS VERIFICATION

A. General: Verification of HVAC System cleanliness will be determined after mechanical cleaning and before the application of any treatment or introduction of any treatment-related substance to the HVAC system, including biocidal agents and coatings.

B. Visual Inspection: The HVAC system shall be inspected visually to ensure that no visible contaminants are present.

1. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean; however, the **Owner** reserves the right to further verify system cleanliness through Surface Comparison Testing or the NADCA vacuum test specified in the NADCA standards.
2. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.
3. NADCA vacuum test analysis should be performed by a qualified third party experienced in testing of this nature.

C. Verification of Coil Cleaning

1. Cleaning must restore the coil pressure drop to within 10 percent of the pressure drop measured when the coil was first installed. If the original pressure drop is not known, the coil will be considered clean only if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection (see NADCA Standards).

2.7 PRE-EXISTING SYSTEM DAMAGE

A. Contractor is not responsible for problems resulting from prior inappropriate or careless cleaning techniques of others.

2.8 POST-PROJECT REPORT

A. At the conclusion of the project, the Contractor shall provide a report to the **Owner** indicating the following:

1. Success of the cleaning project, as verified through visual inspection and/or gravimetric analysis.
2. Areas of the system found to be damaged and/or in need of repair.

2.9 APPLICABLE STANDARDS AND PUBLICATIONS:

The following current standards and publications of the issues currently in effect form a part of this specification to the extent indicated by any reference thereto:

A. National Air Duct Cleaners Association (NADCA): "Assessment, Cleaning & Restoration of HVAC Systems (ACR 2005)," 2004.

B. National Air Duct Cleaners Association (NADCA): “Understanding Microbial Contamination in HVAC Systems,” 1996.

C. National Air Duct Cleaners Association (NADCA): “Introduction to HVAC System Cleaning Services,” 2004.

D. National Air Duct Cleaners Association (NADCA): Standard 05 “Requirements for the Installation of Service Openings in HVAC Systems,” 2004.

E. Underwriters’ Laboratories (UL): UL Standard 181.

F. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE): Standard 62-10, "Ventilation for Acceptable Indoor Air Quality".

G. Environmental Protection Agency (EPA): "Building Air Quality," December 1991.

H. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): “HVAC Duct Construction Standards - Metal and Flexible,” 1985.

I. North American Insulation Manufacturers Association (NAIMA): "Cleaning Fibrous Glass Insulated Air Duct Systems," 1993.

END OF SECTION 23 13 14

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.

B. The General Requirements in Section 200050 shall also govern the work under this Section.

C. Examine all drawings and data and coordinate the work of this Section with all related and adjoining work.

1.2 SCOPE OF WORK:

A. This Contract includes all labor, material, equipment, tests and appliances required to furnish and install all HVAC as shown on drawings, implied and herein specified.

B. The present location of the building will be as shown on drawings. Visit the site and examine the Architectural and other Mechanical trades showing all details of construction before submitting proposal.

C. Connect all equipment with piping, ductwork and controls and leave ready to operate. Check all Architectural Mechanical and Electrical drawings and coordinate all work accordingly.

D. Provide seismic restraints, vibration isolators and flexible connections in accordance with Section 230548. Provide flexible connections at all locations where pipes cross building seismic or expansion joints. Coordinate with Architectural.

E. Drawings are diagrammatic and indicate the general arrangement of piping and do not show all minor details and fittings. Such items shall be included, as well as reasonable modification, in the layout as directed to prevent conflict with other trades. Attention is brought to Section 200050, "Coordination Drawings".

1.3 SUBMITTALS:

A. In accordance with Section 200050, the following items shall be submitted for review.

Pipe and fittings
Unit Ventilators
Coils
Condensing Units

1.5 ACCESS DOORS AND PANELS:

A. Furnish and set access doors and frame for all valves and controls which are concealed in furred spaces. All access doors shall be furnished in Milcor, of flush type with frame and all doors shall be hinged with flush catches. Provide non-ferrous in all wet areas. Access doors shall be fire rated consistent with wall or ceiling in which they are installed.

B. Where access is required to valves, etc., that occur above lay-in ceilings, these access doors can be omitted, provided suitable plastic markers identifying exact location of valves etc., on lay-in ceilings are applied directly below valve grouping and identified by a number, this number to be used as a marking on valve chart. Markers shall be applied to the ceiling grid, not the ceiling tile.

PART 2 -PRODUCTS

2.1 PIPE HANGERS:

A. Securely hang and anchor pipe as shown and required with proper provision for expansion, contraction and elimination of undue stress and strain on piping.

B. Provide a pipe hanger within two (2) feet of each elbow, tee, wye, valve, strainer and similar device.

C. Secure and support runs at base and at sufficiently close intervals to hold pipe at alignment and to carry safely the weight of piping and contents without undue stress thereon.

D. Except as indicated to the contrary, secure and support all horizontal piping as follows and required to prevent sagging, undue pipe movement and preserve proper alignment in each run.

Piping	Sizes	Maximum Interval
Copper Tubing	1 1/4" & smaller	Five (5) feet
Copper Tubing	1 1/2" & larger	Eight (8) feet

E. Hangers up to and including 2" shall be the adjustable band type equal to Empire. Figure 310 for iron pipe and Fig. 310CT for copper tubing.

F. Hangers for piping 2-1/2" and up shall be the clevis type, equal to Empire. Figure 11 for iron pipe and Figure 110CT for copper tubing.

G. Hangers shall be suspended from one of the following devices:

1. "C" clamps.
2. Trapeze hanger assemblies consisting of back-to-back horizontal steel channels with end-type rod hangers.
3. Expansion shield embedded into concrete or masonry.

H. On refrigerant systems, provide over-sized hangers.

I. Refer to Section 230548 for Seismic Restraints.

2.2 FLOOR AND CEILING PLATES:

A. Furnish and install satin chrome plated pressed metal floor and ceiling plates on all exposed pipes passing through floors, walls, ceilings, and partitions throughout.

2.3 REAMING OF PIPES:

A. All pipes to be carefully reamed after cutting and threading.

2.4 PIPE ANCHORS:

A. Furnish and install all steel clamps around mains not less than 1/4" thick and welded to pipe and necessary angle braces to substantial construction to meet job conditions. Anchored mains shall be properly guided.

B. Vertical risers, if any, shall be anchored by similar clamps secured to floor, concealed in wall construction.

2.5 HANGERS AND SLEEVES:

A. All horizontal piping shall be supported in a good, firm and substantial manner. No chains, horizontal pieces of pipe or hangers formed by means of perforated steel bands, pipe rings and hooks will be permitted. Provide cast iron ceiling plates for all hangers in finished basement ceilings. All hangers shall be oversized

B. Furnish and place "Hole-Outs" plastic preformed knockout sleeves for all pipes passing through concrete or tile floors or partitions. All pipes passing through toilet room and mechanical room floors shall be provided with grouted, split Schedule 80 steel pipe sleeves, packed with hair felt and Portland cement to allow for flushing of floors without leakage. All pipes and conduits passing through floors, walls or partitions shall be provided with sleeves sized to give a minimum of 1/2" clearance between sleeve and the outside diameter of the pipe, conduit or insulation, enclosing the pipe or conduit.

C. Sleeves through concrete floors or interior masonry walls shall be Schedule 40 steel pipe, set flush with finished wall or ceiling surfaces, but extending 2 inches above finished floors or shall be in accordance with details on drawings. In all mechanical equipment rooms or penthouses, sleeves shall extend 6 inches above finished floor.

D. All outside piping passing through exterior walls, foundation walls and floors shall be furnished with flanged C.I. wall sleeves in Zurn, J.R. Smith or Josam. Furnish with flashing clamp where sleeve passes through waterproof membrane.

2.6 PIPE AND FITTINGS:

A. Copper Tubing:

1. Type "L", ASTM Specifications B88, shall be used for water lines.
2. Fittings shall be wrought copper or cast brass solder- joint pressure rated type.
3. Type "K" shall be used for underground piping with flared fittings.

B. Steel Piping:

1. Pipe shall be Standard Wall (Sch. 40) black carbon steel, ASTM A-120, Grade B, with threaded ends for sizes 1/2" through 2", for hot water heating piping.
2. All steam condensate return piping shall be run in (SCH 80) black steel.
3. Fittings shall be standard weight (125 lbs.), cast iron screwed, ASTM A126, Class A, for sizes 1/2" through 2". Piping 2" and under shall be screwed.
4. Victaulic Grade E couplings, fittings and accessories in conjunction with grooved end schedule 40 piping will be permitted in existing and new construction for hot water heating

system.

2.7 PIPE AND FITTINGS:

A. All fittings on welded lines shall be furnished in accordance with ASTM A105 Specification designed for welding. Branch outlets on mains 2-1/2" and smaller to be made with Weldolets or Threadolets. Welding fittings on mains and branches 3" and larger are to be full size of reducing tube designed for welding. All flanged valves 3" and larger and special equipment connections to be installed with weld neck flanges for welded construction.

B. All nipples shall be extra strong as follows: Pipe size 1/2" to 4" - 6" close. Pipe size 5" - 12" - 12" close and of the same material as the piping they are used with.

C. All copper tubing shall be furnished in Type "L" using sweat fittings unless otherwise noted. Copper tubing shall be furnished in Chase, Anaconda, Bridgeport or Revere.

D. All black steel over 4" or other welded pipe shall have long radius welding ells and tees of the same wall thickness as the pipe. Welding tees will not be required where the mains and branches comply with the following schedule:

Min. Size of Mains	Max. Size of Branch
2 1/2"	3/4"
3"	1 1/4"
4"	2"
5"	3"

E. Welding flanges shall be slip-on or welding neck type, 300 psig forged steel conforming to ANSI Specification B-16.5.

F. All necessary precautions shall be taken when welding in the new building to prevent combustion of structure.

2.8 PIPING JOINTS:

A. Welded Joints shall be fusion welded in accordance with American Standard B31.1, Section 6, except as modified hereinafter. Changes in direction of piping shall be made with welding fittings only. Mitering, notching or direct welding of pipe to the main in order to form tees or ells will not be permitted. Branch connections may be made with welding tees or forced branch outlet fittings, as manufactured by Bonney Forge, either being acceptable without size limitation. Bonney Thredolets shall be used in lieu of Hald couplings when reducing from a welded run to a screwed branch. Outlet fittings where used shall be forged, flared for improved flow where attached to the run, reinforced against external strains and designed to maintain full pipe bursting strength. Fillet welds shall be used for welding screwed and slip-on steel flanges to pipes. Where lateral connections are to be used, either lateral fittings or Bonney Latrolets are acceptable. Wedded joints shall be used in finished areas with no ceiling.

B. Screwed Joints: The ends of pipes to be threaded shall be cut square and reamed. Pipe threads shall be standard taper, shall be cut straight and clean and to full depth, and shall be free from dirt, chips and burrs when the joint is made. Pipe joint lubricant or compound shall be selected for the pipe line service and shall be applied to male threads only. Screwed joints shall not be caulked.

C. Flanged Joints: This heading covers flanged joints of all types, including those made with flange unions. Flanged joints shall be made with suitable reinforced gaskets. Clean all parts and align the joint before assembling; support pipes or heavy parts independently. Opposite bolts shall be pulled up successively. Screwed steel flanges shall be welded to pipes; slip-on steel flanges shall be welded front and back.

Cast iron flanges shall not be welded to pipes. If raised face flanges are to be bolted against plain face flanges, the raised face shall be removed and a full face gasket used. Where flanged base elbows are installed, the base shall not be used for anchoring the line or otherwise subjected to tension or shear.

D. Soldered Joints in Copper Tubing: Cut the ends of tubes square, remove burrs, clean tube ends and fitting sockets with emery cloth and remove all particles before applying flux and making the joint. Insert tubes to full socket depth. Use the following solders at the given conditions.

95 - 5% Tin-Antimony/all services/high pressure 250 degrees F. Max.
Silver - 35 to 45% alloy-refrigerant piping/high pressure and temperature.

2.9 VALVES:

A. This Contractor shall furnish and install valves where shown on plans and also wherever necessary to make the system complete in its operation. All valves shall be as manufactured by Stockham, Jamesbury, Centerline, Appollo, Milwaukee and Victaulic.

Hot Water Heating:

2" and smaller	
Ball valves	Apollo 71-100/200
Check valves	Stockham B-310-T
Vertical check valves	Stockham B-310-T
2-1/2" and larger	
Butterfly valves	Stockham - LG712-BS3-B (Lug Style)
Check valves	Centerline - Series 800 S.S. plate and spring, and nypalon seats.

Furnish all valve materials suitable for service intended. No gate valves shall be allowed. Provide all valves with factory installed extension stems.

2.10 UNIONS:

A. All unions shall be furnished in Nibco-633 or equal in Chase, Revere, Jefferson and Anaconda.

2.11 GASKETS:

A. Where flanges occur, they shall be packed with Klinger or approved equivalent high quality non-asbestos material composed of fibers for industrial maintenance service with high chemical stability and heat resistance. Nitrile rubber bonded.

Temperature 750 deg. F. max.

Pressure	1450 psi max.
Compressibility	ASTM F36A
Tensile Strength	ASTM F152

2.12 REAMING OF PIPES:

A. All pipes to be carefully reamed after cutting and threading.

2.13 SPECIALTIES FOR HOT WATER SYSTEM:

A. Furnish and install all hot water equipment in Bell & Gossett as specified below and as shown on the drawings.

1. Pressure reducing valve for each closed system.
2. Provide B&G circuit setter plus calibrated balancing valves Model C.B. on all radiation and air handling equipment.

B. Furnish and install the following accessories and equipment in make other than Bell & Gossett.

1. Thermometers: Install Ashcroft Fig. 7173T BI-Metal "Every Angle" thermometers where shown and/or called for on plans or in specifications.
2. Thermometers shall have 5" aluminum hermeticism sealed case with stainless steel stem with 1/2" NPT connection. Install in separable well in brass with lagging extension neck. Stem length and dial range shall be 6" and 0 degrees to 250 degrees F., respectively.
3. Furnish and install on non-critical systems, gauges suitable for use on hot water where indicated on drawings or called for in specifications. Gauge shall be Ashcroft Fig. 2070 with silver brazed boudon tube, aluminum back flange type epoxy coated case, chrome ring, 1/4" NPT lower connection, stainless steel movement with 1% accuracy. Pressure range shall be as required. Furnish 1/4" needlepoint valve in Crane #88 for each gauge. Where sharp pressure fluctuations may occur, mount gauge on a 1/4" Fig. 1106B pulsation dampener. Provide compound gauges where required or called for.
4. Furnish and install balancing valves on supply and return mains and branch mains from 1-1/2" and larger.
5. Expansion fittings shall be provided in Flexonics Type H expansion joints, sized as required to take up all expansion in mains and/or branches or equal in Anaconda.
6. Furnish and install all balancing valves on radiation, air handling unit coil, fan coil unit coil, cabinet and unit heater coil, etc., runouts 2" and smaller in Tour Andersson STA-D Series with ""A metal"" construction. Branch mains 2 1/2" and larger shall be provided with Tour Andersson STA-F Series balancing valve.
7. Furnish and install dielectric fittings.
8. Furnish and install brass cap with chain on all strainers, drains and hose connections.

2.14 REFRIGERANT PIPING:

A. All refrigerant piping shall be installed in compliance with all state and local code requirements.

B. Contractor shall field verify piping length and layout with the equipment manufacturer prior to start of any work. Contractor shall submit a shop drawing showing refrigeration pipe layout, lengths and pipe sizes prior to start of installing any refrigeration piping.

C. Refrigerant piping shall be copper tube ASTM B 280, Type ACR, hard-drawn straight lengths

or soft-annealed coil, seamless copper tubing. Tubing shall be factory cleaned, ready for use and installation, and have ends capped to protect cleanliness of pipe interior.

D. Fittings shall be Wrought-Copper fittings ANSI B16.22, streamline pattern.

E. Tubing shall be joined using brazing filler material such as phoscopper or silver alloy. Comply with the procedures contained in the AWS "Brazing Manual". Contractor shall take all appropriate precautions when conducting brazing work to protect the building and people from fumes, fire and smoke. Fill pipe with inert gas such as dry nitrogen to prevent formation of scale while brazing.

F. Contractor shall coordinate and provide all refrigeration piping specialties as required by the refrigeration equipment manufacturer to ensure a complete and functioning refrigeration system. Refrigeration specialties shall be UL approved, listed and shall conform to ASI 760.

G. Install refrigerant piping in accordance with ASHRAE standard 15. Install piping in as short and direct manner as possible to minimize pressure drop and refrigerant volume. Install using the fewest number of joints and fittings as possible.

H. Arrange piping to allow for inspection, leak testing, and servicing of the fittings and adjacent equipment. Allow for adequate service clearances of piping and equipment.

I. Provide insulation for refrigeration piping and condensate drain piping as recommended by the equipment manufacturer. If the manufacturer does not have any insulating requirements or recommendations then the contractor shall at minimum insulate the suction line from the evaporator to the condensing unit (compressor inlet) and the condensate drain line.

Do not install insulation until all refrigerant piping has been tested and proven to be free from leaks. Insulation shall be UV resistant and shall comply with NFPA requirements for fire and smoke developed rating for foam and insulating materials.

J. All penetrations shall be sleeved and shall be sealed. Provide weather tight seal for exterior pipe penetrations and firestopping for interior penetrations. Materials shall be of an approved type for the application.

K. If necessary to remove refrigerant from the system the contractor is expected to adhere to all regulations and procedures governing reclaiming of the refrigerant. Under no circumstances may refrigerant be purged or released to the atmosphere.

L. The contractor shall test all refrigerant piping and completely evacuate the refrigerant system using a vacuum pump. Contractor shall create a vacuum within the system corresponding to a temperature of 35 deg F on a vacuum dehydration indicator. Contractor shall valve off pump and inspect that system vacuum is maintained for a minimum of five (5) hours. Contractor shall then break vacuum using the approved refrigerant for the equipment connected to the piping system. Allow pressure to build gradually to a minimum holding charge pressure of 5 psi.

M. Contractor shall measure and fill the refrigerant system with the type and quantity of refrigerant specified by the refrigeration equipment manufacturer. Contractor shall also take pipe volume and other additional line volume into account when charging the system. Contractor shall verify that sufficient operating charge is provided and leave system in full operating order.

PART 3 -EXECUTION

3.1 INSTALLATION:

A. Furnish and install the hot water piping to the Unit Ventilators and Cabinet unit Heaters as shown on plans. Furnish and install all control valves, flow valves, air vents, gate valves and/or balancing valves and drain valves.

B. Provide hot water shutoff valves and combination shutoff and balancing cock for all equipment, hose cocks and drain valves at all low points. Furnish and install balancing cocks on return flow of each CUH.

C. Provide balancing cocks on all main branches for balancing flow to and from the various zones. Provide on all low points of mains or branches, brass hose cocks with hose connection for draining the system.

D. Check all architectural, plumbing and electrical drawings to make sure that his piping will not conflict with such work.

E. All piping work shall be installed with proper provision to allow for expansion and contraction of lines so as to prevent any undue strains on pipe and fittings, any trapping of lines or lifting or dislocating of any appliances. Rectify without cost to the Owner any conditions of noisy circulation due to trapped or air bound lines, including the expense of cutting and repairing of the building structure incident to making such alterations.

F. Install the work to conform to space conditions and the work of other trades. The drawings indicate generally the runs and sizes of piping and, although the size must not be decreased, nor the drawings deviated from, except as unforeseen space conditions may require, the right is reversed to make minor changes in the arrangement of the work to meet conditions arising during construction.

G. Check all architectural to determine seismic and expansion joint location. Provide expansion fittings at all locations where pipes cross expansion or seismic joints. Coordinate with Architectural for locations.

3.2 MISCELLANEOUS PIPING:

A. Furnish and install copper drain lines from air plenums and cooling coil drain pans and extend to floor drain, service sink and/or sump whether or not same is shown.

3.3 TESTING:

A. All flow piping shall be tested and made tight.

B. All piping, including hot water piping, shall be tested and made tight at 100 psi or 50 psi above the city pressure before any piping is concealed or approved.

C. After the system is thoroughly cleaned, it shall be put into operation by this Contractor. All parts of the system shall be thoroughly tested and this Contractor shall carefully instruct the Owner's authorized representative as to the proper operation and are of the entire system.

D. All low pressure piping shall be tested and made tight at 100 lbs. per square inch hydrostatic pressure before any piping is concealed or covered.

E. Contractor shall waste all returns for a minimum period of two weeks after all steam lines, return lines and heating surfaces have been connected up and in operation or until all traces of grease, oil and dirt disappear.

F. After the systems are thoroughly cleaned, they shall be put into operation by the Heating Contractor after all traps and strainers have been removed and cleaned. All parts of the system shall be thoroughly tested and this Contractor shall carefully instruct the Owner's authorized representatives as to the proper operation and care of the entire system.

3.4 FLUSHING OUT SYSTEM:

A. Contractor shall flush out the heating water systems before balancing up the systems.

3.5 BALANCING AND VENTING OF HOT AND CHILLED WATER SYSTEM:

A. Contractor shall provide all labor and materials as required to assist the Balancing Contractor in proper balancing of the water systems. Contractor shall return to the job and shall make necessary adjustments and corrections to the systems as required by the Balancing Contractor in order to achieve satisfactory system performance in accordance with design parameters.

B. Contractor shall carefully vent the system when filling same and return to the job during the eighteen months guarantee period as required, to assure the Town of a proper operating system.

C. System shall be slowly filled with cold water to purge air and shall maintain 4 psig on a gauge located conveniently near the top of the system.

END OF SECTION 23 21 13

SECTION 23 82 23 –UNIT VENTILATORS

PART 1: GENERAL

1.1 RELATED DOCUMENTS:

A. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.

B. The General Requirements in Section 200050 shall also govern the work under this Section.

C. Examine all drawings and data and coordinate the work of this Section with all related and adjoining work.

1.02 WORK INCLUDED

A. The contractor shall furnish and install packaged unit ventilator systems, of the capacities, performance, and configuration, as indicated in the unit schedule. Each unit shall be complete with factory furnished components and accessories as shown in the plans and as specified herein.

B. Electrical work required as an integral part of the temperature control work is indicated on the mechanical drawings, and is the responsibility of the HVAC contractor to hire the services of a temperature control contractor and/or system integrator contractor to provide a complete system to perform the sequence of operation shown, or as described in this specification. The full sequence of operation must be provided and installed by this contractor for all trades.

C. The unit ventilators shall be furnished with direct expansion heat pump coils designed to work with the DAIKIN VRV split system condensing units.

1.03 SUBMITTALS

A. Submit schedule for all types, sizes and accessories. Schedule shall include certified performance data, room locations and all operating data.

B. Submit shop drawings for all units including all dimensional information, construction details, installation details, required opening sizes, roughing locations for piping and electrical work and accessory equipment. Equipment must meet specifications. Where deviations from the specifications exist, they must be identified.

C. Provide field wiring diagrams for all electrical power and temperature control field-wiring connections.

D. Submittals shall also include complete operating and maintenance instruction manuals and unit specific replacement parts lists.

1.04 QUALITY ASSURANCE

A. Unit ventilators shall be listed by Underwriters Laboratories Inc. (U.L.) for the United States and Canada.

B. Motors shall conform to the latest applicable requirements of NEMA, IEEE, ANSI, and NEC standards.

C. Unit ventilation rate to be certified and tested per Air Conditioning and Refrigeration Institute (ARI) standard 840.

D. Unit to be certified and labeled compliant with the seismic design provisions of the International Building Code (IBC) Chapter 16 and independent test agency requirements of Chapter 17.

PART 2: PRODUCTS

2.01 Unit Ventilators: Manufacturer Daikin or approved equal in Trane

2.02 Cabinet and Chassis:

A. Unit frames shall be of unitized, welded construction, with structural elements aligned in an assembly jig prior to welding, to insure proper dimensions, rigidity, and squareness. Frames assembled with mechanical fasteners shall not be acceptable.

B. Internal sheet metal parts shall be constructed of galvanized steel to inhibit corrosion.

C. Exterior cabinet panels shall be fabricated from furniture grade steel of not less than 16 gauge steel with no sharp edges and no unsightly screw heads and shall receive an electro-statically applied powder paint, and be oven baked with environmentally friendly thermosetting urethane powder finish to provide a high quality appearance. Finish color shall be as selected by Engineer from manufacturer's standard colors.

D. The interior areas of the unit ventilator shall be insulated for sound attenuation and to provide protection against condensation of moisture on or within the unit. The unit shall be provided with an ultra-quiet sound package consisting of acoustically matched low speed fans to fan housing, sound barrier insulation material (non-fiberglass) adhered to the bottom underside of the unit top panel, sides of the fan section and sound absorbing insulation (non-fiberglass) material applied to the unit front panel.

E. Units shall be constructed so that testing and troubleshooting can be accomplished in the end pockets of operating units, without affecting the normal air flow patterns through the unit.

F. Each unit shall be provided with a non-fused power interrupt switch that disconnects the main power to the unit for servicing or when the unit is to be shut down for an extended period of time. The fan motor and controls shall have the hot line(s) protected by factory installed cartridge type fuse(s).

G. The manufacturer shall have published cataloged sound data available for the engineer's review. Sound data shall have been conducted using a qualified reverberant room per ANSI S1.31 and ANSI S12.32. Sound test data shall be based on standard cfm at standard air (fixed density of air at 70F) in accordance with ARI procedures based upon ARI 350. The engineer shall have the right to reject equipment not conforming to the specified manufacturer's sound data, as a minimum. Sound levels shall not exceed those shown below:

Octave Band and Center Frequency (Hz)								
UNIT CFM	Speed	2 125	3 250	4 500	5 1000	6 2000	7 4000	8 8000
	High	57.4	51.8	52.5	52.6	51.2	46.9	35.2
750	Med.	50.1	44.9	45.6	44.8	42.8	34.2	19.9
	Low	45.6	40.4	40.8	39.1	35.7	24.4	12.0
	High	57.0	52.8	53.9	53.7	51.5	46.8	35.9
1000	Med.	52.9	48.6	50.2	49.6	46.5	40.1	27.9
	Low	49.4	45.4	47.0	45.5	42.0	33.6	20.7
	High	62.4	55.2	55.7	55.3	54.4	49.7	38.5
1250	Med.	59.3	52.1	52.5	51.7	50.4	44.0	31.8
	Low	55.6	48.6	49.1	47.2	45.6	37.1	24.0
	High	63.8	56.6	58.0	58.2	56.4	52.4	41.9
1500	Med.	58.4	51.3	52.7	52.4	49.5	43.5	30.5
	Low	54.8	47.6	49.4	47.5	44.2	36.2	21.5
Sound Power Levels - dB re 10 -12 watt								

- Test data based on a valve control unit having 3 rows of coil and no outdoor air. Sound Power data may vary based on the type of unit, number of coil rows and other external factors.

2.03 Floor Units:

A. Floor mounted units shall have an integral pipe tunnel for convenient crossover of piping and a built-in metal wire raceway from right end compartment to left end compartment to contain any line voltage electrical wiring separate from the air stream. Line voltage wiring shall not be touchable in the air stream of the unit during normal maintenance procedures of oiling bearings or motors. Unit shall come standard with a factory installed and wired disconnect switch.

B. Unit top surface shall be supplied with a charcoal bronze textured finish, to resist scuffing, reduce glare and help hide fingerprints. Unit top shall have two access doors, one at each end (for access to motor and bearings for easy servicing). The front and ends shall be available in a selection of architecturally pleasing colors by the manufacturer, for selection by the Architect.

C. Unit discharge grille shall be constructed of continuous rounded edge steel bars to provide 10 degree vertical deflection. A 1/4" painted, galvanized mesh screen shall be provided beneath the discharge grille to protect against objects being dropped through the discharge grille.

D. The unit top and grille shall be of a modular construction so that it is removable for service and maintenance.

E. The unit front surface shall be comprised of three separate removable panels. The controls and piping shall be accessible without removing the entire front panel. Panels shall be secured to the unit with recessed, tamper resistant, Allen head fasteners. Slots for flat head screwdrivers shall not be acceptable as tamper resistant.

F. An extended cabinet depth unit, 21 7/8” deep, shall incorporate a full adapter back with closed pipe tunnel with the same features of the standard cabinet depth units with the additional capability of bringing in fresh air from 1” to 28” from the floor. The unit top, back and vertical adapter back partitions shall be insulated and sealed to form a thermal barrier. The vertical and horizontal insulated metal extensions shall have a 1” wide compressible gasket to form an airtight seal between the wall and the unit. A field removable horizontal support plate between the unit bottom and top to achieve the 1” to 28” fresh air access shall not be acceptable.

2.04 Coils:

A. Coil assembly shall be of a modular construction so that it is removeable from the front of the unit.

B. All coils shall be installed in a draw through position to assure uniform air distribution over the full-face area of the coil, and an even unit discharge temperature.

C. All heating and cooling coils shall be constructed with copper tubes and mechanically bonded aluminum corrugated plate type fins. All coils shall have aluminum individual unshared fin surfaces. An air break shall exist between coils.

D. Hot water heating shall be furnished with a threaded drain plug at the lowest point and a manual air vent at the high point of the coil. A factory installed low temperature freezestat shall be provided on the leaving edge of the water heating coil in a wave-like configuration to sense multiple locations and shall react to possible freezing conditions. The unit-mounted controls shall incorporate this device.

2.05 Drain Pan

A. All units shall come furnished with an insulated drain pan constructed of stainless steel. A drain outlet shall be provided on both ends of the drain pan with one outlet capped. The drain hand of connection shall be easily field-reversed by relocating the cap to the opposite end without disassembly of the unit or movement of the unit drain pan.

B. The drain pan shall be able to be sloped in either direction for proper condensate removal.

C. Drain shall be provided with a secondary, overflow drain connection on both ends of the pan.

D. Contractor shall be responsible for piping condensate to drain.

2.06 Fans and Motor:

A. The fan and motor assembly shall be of a low speed design to assure maximum quietness and efficiency.

B. Fans shall be double-inlet, forward-curved, centrifugal type with offset aerodynamic blades. Fans and shaft shall be statically and dynamically balanced as an assembly in the unit before shipment.

C. Fan housings shall be constructed of galvanized steel incorporating logarithmic expansion for quiet operation. Fan and motor assembly shall be of the direct drive type. Belt drive fans shall not be allowed.

D. Motors shall be 208 volt, single phase, 60 Hz, Variable Speed ECM motors. Motors shall be located out of the conditioned air stream.

E. All components of the fan/motor assembly shall be removable from the top of floor-mounted units.

F. Units shall have sleeve type motor and fan shaft bearings , and shall not reqiure oiling more than annually. All bearings shall be located out of the airstream. Bearings in the air stream are not acceptable.

2.07 Face & Bypass Damper:

A. Each unit shall be provided with a factory-installed face and by-pass damper, constructed of aluminum. The long sealing surfaces of the damper shall seal positively against stops fitted with extruded EPDM rubber seals. Face and bypass dampers without sealing edges to prevent air bypass shall not be acceptable. The damper ends shall have blended mohair seals along the ends glued to the damper end for a positive seal. Plastic clip-on brush end seals shall not be acceptable as an end seal.

The unit design shall incorporate the face and bypass damper to prevent coil surface wiping and be before the fan in a draw-thru configuration. The face and by-pass damper shall be arranged to have a dead air space to minimize heat pick-up in the by-pass position.

2.08 Outdoor & Room Dampers:

A. Each unit shall be provided with separate room air and outdoor air dampers.

B. The room air damper shall be two-piece, double-wall construction fabricated from aluminum, and be counterbalanced against backpressure to close by gusts of wind pressure, thereby preventing outdoor air from blowing directly into the room.

C. The outdoor air damper shall be two piece, double wall construction fabricated from galvanized steel, with ½" thick, 1½ lb. density glassfiber insulation encapsulated between the welded blade halves for rigidity and to inhibit corrosion. The outdoor air damper shall have additional foam insulation on the exterior surface damper blade and on the ends of the outdoor air chamber. A single blade damper, which can be twisted and will leak air, will not be considered.

D. Dampers shall be fitted with blended mohair seals along all sealing edges. Pressure adhesive sponge neoprene or plastic clip-on brush type sealers for damper seals are not acceptable. Rubber type gasket using pressure adhesive for fastening to metal and exposed to the outside air is not acceptable.

E. Dampers shall use the turned-metal principle on long closing ends with no metal-to-metal contact for proper sealing.

F. The damper shaft shall be mechanically fastened to the blade, and shall operate in bearings made of nylon or other material which does not require lubrication.

2.09 Filter:

A. Each unit ventilator shall be equipped with a Dynamic Air filter located to provide filtration of the return air/outdoor air mixture, in lieu of separate filters for each air stream. The entire filter surface must be useable for filtration of 100% room air or 100% of outdoor air. The filter shall be easily accessible from the front, and removable without removal of the unit return air damper stop. The unit shall ship with a factory installed 1" thick Dynamic panel filter to provide MERV-13 equivalent filtration. The filter shall be wired to the control panel.

2.010 Control Components:

A. The hot water heating coil shall use a factory furnished, field installed, two position End Of Cycle (EOC) control valve to shut off the heating medium at the end of the heating cycle. Upon a power failure, the heating EOC valve shall spring return to the normally open position for flow of water. End of cycle valves without spring return to the normal position upon a power failure shall not be acceptable. The EOC shall be of the 2-way or 3-way configuration as specified in the valve specifications.

B. A room humidity sensor shall be factory located in a sampling chamber (front, center panel) where room air is continuously drawn through for fast response to humidity changes in the room for units capable of passive dehumidification or for units using indoor/outdoor enthalpy type economizer.

C. Each unit ventilator shall be furnished capable of accepting direct coupled damper actuators and with a factory installed low temperature freezestat provided on the leaving edge of the water heating coil in a wave-like configuration to sense multiple locations and shall react to possible freezing

conditions. The temperature control contractor shall be responsible for the proper operation of controls to prevent damage of any unit ventilator components while ensuring comfort.

D. Each VRV unit ventilator will be furnished with a Daikin VRV expansion valve controller, on board thermostat located inside a locked cover and electronic expansion valve capable of operation with the DAIKIN VRV inverter duty compressor and controls.

E. Unit manufacturer shall factory install ATC provided Control Components. Control integration, graphics, scheduling, mode selection, fan speed shall be driven by the ATC.

2.011 Control Functions:

A. The Unit Ventilator Digital Controller (here after referred to as UVDC) shall support ASHRAE Cycle II operation. The control cycle shall be used to maintain the required minimum amount of ventilation whenever possible, which can be increased during normal operation for economizer cooling, but can also be reduced to prevent excessively cold discharge air temperatures.

B. Cool Mode: Cooling shall be provided through the DX heat pump coil and integrated controls of the Daikin VRV condensing unit, EKE control module and electronic expansion valve.

C. Heating Mode: Heating shall be provided by two sources. One stage shall be by the DX heat pump coil and integrated controls of the Daikin VRV condensing unit, EKE control module and electronic expansion valve and shall provide heating on an owner/engineer specified schedule. A second stage of heating shall be by the integrated hot water heating coil and modulating valve.

2.012 Unit Ventilator Options / Accessories:

A. Outdoor Air Intake Louver: Outdoor air intake louver shall be provided by unit ventilator manufacturer except as otherwise noted on the drawings. **(SELECT one:)**

1. Masonry wall intake louver shall be constructed with horizontal chevron type blades. Provide weep holes in the louver frame and diamond pattern expanded aluminum bird screen on the interior side. Louver shall be fabricated of extruded aluminum 6063-T5. The intake assembly and frame shall be 16 ga. horizontal chevron type aluminum blades in a 12 ga. frame, with (SELECT) [1. unfinished capable of field painting], OR [2. manufacturer’s oven baked powder paint finish and color for selection by the Architect], OR [3. clear anodized finish].

2.013 Basis of Design:

A. AAF-HermanNelson by Daikin Applied

B. Acceptable Alternates:

1. Trane - With prior approval only. Submit detailed listing of all variations in form, fit, or function, in addition to specified submittal data for approval before bidding; the request must be received at least three (3) business days prior to the advertised response deadline. Equipment or manufacturers not listed in this specification shall not be acceptable or approved for installation. Provide required information as specified in Section 01350.

PART 3: EXECUTION

3.01 INSTALLATION

A. Install all equipment in strict accordance with manufacturer's instructions and so as to be compatible with the intent of the respective system performance requirement.

B. The System Integrator/Controls contractor shall be responsible for the integration of all factory provided unit mounted controls and unit communications as required/specified for unit integration into the Building Automation System and proper unit operation.

C. Contractor shall clean each unit and accessory section of construction dust and debris, prior to turning systems over to the owner.

D. Contractor shall install clean filters in each unit at time of system commissioning, and shall deliver to the owner one complete set of spare filters, and one spare motor of each type used in the project.

E. System Integrator/Controls contractor shall be responsible for the integration of all factory provided unit mounted controls and unit communications as required/specified for unit integration into the Building Automation System and proper unit operation.

F. Installer shall engage the services of manufacturer's factory trained service technician to provide check, test, and start-up of each unit ventilator system.

G. Contractor shall provide one-year warranty for furnishing parts and labor for replacing any part of the unit ventilator or accessory sections, which becomes defective in operation. Unit ventilator manufacturer's representative shall maintain a local stock of replacement parts to support the systems specified herein.

H. Contractor shall submit a completed “Check Test and Start Sheet" for each Unit Ventilator installed for verification of proper installation and start up.

END OF SECTION 23 82 23

SECTION 26 00 00 - GENERAL ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General Provisions of the Contract, including General and Supplementary Conditions and Division 1, General Requirements, apply to the work specified in this Section.

B. The requirements in Section 260000 shall govern the work of all Sections of Division 26.

1.2 SCOPE OF WORK:

A. Scope of work consists of installation of materials to be furnished under these Specifications and without limiting generality thereof consists of furnishing labor, materials, equipment, hoisting, plant, transportation, rigging, staging, appurtenances, and services necessary and/or incidental to properly complete all electrical work as shown on drawings, as described in the Specifications or as reasonably inferred from either as being required in opinion of the Engineer.

B. Work Included: Provide complete electrical services where shown on the drawings, as specified herein and as needed for a complete and proper installation including but not necessarily limited to:

1. Demolition.
2. Receptacles.
3. Panelboards.
4. Feeders.
5. Branch circuit wiring for receptacles and HVAC equipment.

1.3 SITE CONDITIONS:

A. Prior to submitting bid, visit the site and identify existing conditions and difficulties that will affect work called for by the Contract Documents.

B. No compensation will be granted for additional work caused by unfamiliarity with site conditions that are visible or readily construed by experienced observers. Include in the bid amount all demolition work required.

C. The Contractor shall verify and obtain all necessary dimensions at the site.

1.4 DEFINITIONS:

A. Furnish: The word "furnish" is used to mean "supply and deliver the referenced item to the project site, ready for unloading, unpacking, assembly, and installation".

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

C. Normally Occupied: The words "normally occupied" are used to mean "all rooms within a building except for crawlspaces, underground tunnels, attic spaces, mechanical rooms, telephone rooms, data distribution rooms, and electrical rooms".

D. Or Approved Equal: The words "or approved equal" are used to mean "any product which in the opinion of the Engineer is essentially equal in quality, size, arrangement, appearance, construction, and performance to that product specified or shown on the drawings".

E. Provide: The word "provide" means "to furnish and install the referenced item, complete and ready for the intended use".

F. Remove: The word "remove" means "to disconnect from its present position, remove from the project site, and to dispose of in a legal manner".

1.5 QUALITY ASSURANCE:

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of the Contract Documents.

B. Codes and Regulations:

1. In addition to complying with the specified requirements, comply with all Federal, State and Local Codes wherever applicable including the following: 2018 Connecticut State Building Code, 2015 IBC, 2018 Connecticut Fire Safety Code , 2015 International Fire Code, 2013 NFPA 72 National Fire Alarm Code, 2017 NFPA 70 National Electrical Code, 2015 International Energy Conservation Code, ICC/ANSI A117.1-2009 Accessible and Usable Buildings and Facilities, and ADA.
2. Comply with the requirements of the Local Authority Having Jurisdiction.
3. Materials and equipment shall be UL listed where standard has been established.
4. Perform tests required by specifications, Engineer's instructions, laws, ordinances or public authorities, approvals, and give Owner timely notice. Notify the Owner of dates for inspection by other authorities.
5. In the event of conflict between or among specified requirements and pertinent regulations, the more stringent requirement will govern.
6. Reference made to codes and standards shall be interpreted as minimum requirements. Provide and perform work in excess of codes and standards as indicated by drawings or specifications.

C. Prior to bidding, the Contractor shall give written notice to the Engineer of any materials, equipment, or apparatus believed in the opinion of said Contractor, to be inadequate or unsuitable for the installation, or in violation of laws, ordinances, rules, or regulations of authorities having jurisdiction. The Contractor shall also give written notice to the Engineer of any items, materials, equipment, or work believed in the opinion of said Contractor, to be omitted from the Contract Documents. In the absence of such written notice, it is mutually agreed that Contractor has included the cost of all required items in his bid and that he will be responsible for approved satisfactory functioning of systems without further compensation.

1.6 SUBMITTALS:

A. Refer to Division 1 for submittal procedures.

B. 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. Include the following information on the label for processing and recording action taken:

a. Project name, location, and address
b. Date
c. Name and address of Engineer
d. Name and address of Contractor
e. Name and address of Sub-Contractor
f. Name and address of supplier(s)
g. Name of manufacturer(s)
h. Number and title of appropriate Specification section.

C. Data sheets and catalog cuts, etc. contained in submittals shall be clearly marked in ink indicating specific service or application for which material or equipment is to be used. Data of a general nature and not clearly defining the service or application for which the proposed item is to be used will not be accepted.

D. Submit for review complete diagrams of systems prepared by equipment manufacturer showing connections and equipment. Standard wiring diagrams shall be modified where necessary to specific system.

E. Prior to forwarding submittals and shop drawings for review by the Engineer, the Contractor shall thoroughly check each submittal, reject those not conforming to the specifications, and indicate by his signature that the submittals in his opinion meet the contract requirements.

F. Intent of Shop Drawings and product data review is to check for capacity, rating and certain construction features, ensure that work meets requirements of Contract Documents regarding information that pertains to fabrication processes or means, methods, techniques, sequences and procedures of construction, and for coordination of work between trades.

G. Submittal review shall not diminish responsibility under this contract for dimensional coordination, quantities, installation, piping, supports, access, service and errors, nor for deviations from requirements of contract documents. Noting errors while overlooking others will not excuse proceeding in error. Requirements of contract documents are not limited, waived, nor superseded by shop drawing review.

H. Equipment variations: Where no specific make or material, apparatus or appliance is mentioned in the Contract Documents, any first class product made by a reputable manufacturer may be used, providing it conforms to the requirements of these specifications and meets the approval of the Engineer.

I. Equipment alternates, substitutions, and deviations:

1. Wherever more than one manufacturer is mentioned in the specifications or on the drawings, any of those named shall be considered equally acceptable to that on upon which design was based, and providing all aspects of the specification are met insofar as quality, construction, performance, space requirements, noise levels and special accessories or materials, any of those named may be included in Contractor's bid.
2. Bidders wishing to obtain approval on brands other than those specified by name shall submit their request to the Engineer not less than ten (10) business days before the date fixed for opening of bids. Approval by the Engineer will be in the form of an Addendum to the specifications issued to all prospective bidders, indicating that the additional brand or brands are approved as equal to those specified so far as the requirements of the project are concerned.
3. Wherever a single manufacturer is used in the specifications or on the drawings and is followed by the words "or approved equal" the Contractor must use the item named or he may apply for an alternate equipment deviation through the prescribed manner in accordance with Item 1.6, I, 2.
4. Alternate equipment to that specified or shown on the drawings, as proposed to be provided by the contractor, must be essentially equal in quality, size, construction, and performance to that item specified or shown on the drawings.
5. Submittals for alternate equipment shall list all deviations and differences from the specified equipment. Failure to submit this list will result in rejection of the submittal. Any deviations and differences not listed but discovered after installation shall be rectified as directed by the Engineer at the Contractor’s cost.
6. Furnish samples of alternate equipment proposed to be provided when so requested by the Engineer.
7. Where the Contractor proposes to use an item of equipment which differs from that upon which design was based, which requires any redesign of the structure, partitions, foundations, piping, wiring or of any other part of Mechanical, Electrical or Architectural Layout, all such redesign, new drawings or detailing required shall be prepared by Contractor at his own expense for approval of the Engineer.
8. Where approved substitutions or deviations require a different quantity, size or arrangement of structural supports, wiring, conduit, piping, ductwork, and equipment from that upon which design was based, all additional items required by the systems shall, with the approval of the Engineer, be furnished by the Contractor at no additional cost to Owner.

J. Allow sufficient time so that the delivery and installation of equipment will not be delayed as a result of the time required to review, process and transmit submittals, including resubmittals. Failure by the Contractor to transmit submittals to the Engineer in ample time for review and processing shall not entitle him to an extension of the Contract Time and no claim for an extension of time by reason of such default will be allowed.

K. Submittals, shop drawings, and samples will be reviewed with reasonable promptness and will be stamped indicating appropriate action as follows:

1. “No Exceptions Taken” means that fabrication, manufacture, or construction may proceed providing submittal complies with contract documents.

2. "Amend as Noted" means that fabrication, manufacture, or construction may proceed, providing the submittal complies with Engineer's notations and contract documents.

3. "Resubmit" means that submittal, or equipment proposed to be provided, does not comply fully with the contract documents and that fabrication, manufacture, or construction shall not proceed. Resubmit in accordance with the Engineer's notations and contract documents.

4. "Rejected" means that submittal does not comply with contract documents, or that equipment proposed to be provided does not comply with the specified requirements or is not equal or better in quality and performance than that item specified. Fabrication, manufacture, or construction shall not proceed. Resubmit in accordance with the contract documents and specified requirements.

L. If material or equipment is installed prior to review, or without review, it shall be removed and replaced at no extra charge to the Owner if, in the opinion of the Engineer, the material or equipment is not in compliance with the Contract Documents.

1.7 AS-BUILT DRAWINGS:

A. Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings at the job site. Protect record drawings from deterioration and loss in a secure location. Provide access to record drawings for the Engineer's reference during normal working hours.

B. As work progresses mark the record drawings to show the actual installation where the installation varies from the work as originally shown, whether resulting from Addenda, Change Order, approved submittals, or changes made due to field conditions. Mark whichever drawing is most appropriate for 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 items concealed within the structure or buried below grade.

1. Mark as-built drawings with colored erasable pencils: using separate colors to distinguish between different systems.
2. Include dimensioned locations of conduit runs buried below floor slabs and buried beyond the building footprint.
3. Note related change order numbers where applicable.

C. At the completion of work prepare a new set of black line white-print As-built Drawings, of work as actually installed, incorporating addenda, changes made due to approved submittals, change order work, field changes, and added data, all as shown on the marked-up record drawings maintained at the site. Date the set and clearly mark it as "As-built Drawings".

D. Furnish two sets of the As-built Drawings to the Engineer for review and transmission to the Owner.

1.8 OPERATING AND MAINTENANCE MANUALS:

A. Provide Operating and Maintenance Manuals in accordance with the requirements of Division 1 of these specifications.

1.9 GUARANTEE AND WARRANTIES:

A. Comply with the requirements of Division 1.

B. Obtain in Owner's name written equipment and material warranties offered in manufacturer's published product data without exclusion or limitation.

C. Guarantee work of this Contract in writing for not less than twelve (12) months from date of Substantial Completion. Repair or replace defective materials, equipment, workmanship and installation that develop within this period, promptly and to Owner's satisfaction and correct damage caused in making necessary repairs and replacements under guarantee within contract price.

D. Replace material or equipment that requires excessive service during guarantee period, as defined and as directed by the Engineer.

E. Submit guarantee to the Owner before final payment.

1.10 LAWS, ORDINANCES, PERMITS, AND FEES:

A. Give all necessary notices, obtain all permits and pay all taxes, fees and other costs in connection with the work; file all necessary plans, prepare all documents and obtain all necessary approvals of all Regulation Authorities; obtain all required Certificates of Occupancy and/or Inspections required for the work and deliver same to the Owner before requests for acceptance and final payment for the work.

B. Include in the work, without extra cost to the Owner, all labor, materials, services, apparatus, drawings (in addition to Contract Documents and Drawings) required to comply with all applicable laws, ordinances, rules and regulations.

1.11 CORRELATION OF DRAWINGS AND SPECIFICATIONS

A. In general, the Specifications will describe the "quality" of the work and the drawings the "extent" of the work. The drawings and specifications are cooperative and supplementary; however, and each item of the work is not necessarily mentioned in both the drawings and specifications. All work necessary to complete the project, so described, is to be included in this contract.

B. In case of disagreement between drawings and specifications, or within either document itself, the better quality or greater quantity of work shall be estimated and the matter drawn to the Engineer's attention for decision and/or adjustment. Any work done by any Contractor without consulting the Engineer, when the same requires a decision and/or adjustment, shall be done at the Contractor's risk.

C. Drawings are diagrammatic and indicate general arrangement of systems and work included in Contract. Information and components shown on diagrams but not on plans,

and vice versa, shall apply or shall be provided as though expressly required on both. It is not intended that every fitting or component be specified or shown on drawings; however, Contract Documents require provision of all components and materials necessary for a complete and operational installation, whether or not indicated or specified.

D. Do not scale drawings. Scale indicated on drawings is for establishing reference points only. Actual field conditions shall govern all dimensions. The Contractor shall verify all dimensions at the project site.

E. In all cases where the Contract Documents refer to equipment or apparatus in singular number, it is intended that such reference include as many such items that are required to complete the work.

1.12 ELECTRICAL VOLTAGES:

A. The electrical service to the building is 208Y/120V, 3 phase, 4 wire, 60Hz.

B. All equipment shall be suitable for this electrical supply. It is the responsibility of the Contractor to study the electrical drawings to determine the supply for any particular piece of equipment.

C. If equipment requires other electrical characteristics (voltage and phase) than that supplied and shown on the electrical drawings, transformers and wiring shall be provided with that equipment at no extra cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS AND WORKMANSHIP:

A. Provide only materials that are new and of type and quality specified. Where Underwriters' Laboratories, Inc. have established standards for such materials, provide only materials bearing the UL label.

B. Provide accessories, materials and equipment necessary to make installation complete in every detail, and to conform to manufacturers' latest installation instructions, under this Contract whether or not specifically shown on drawings or specified herein.

C. All component parts of each item of equipment shall bear the manufacturers' nameplate, giving name of manufacturer, description, size, type, serial or model number, electrical characteristics, etc. in order to facilitate maintenance or replacement. Contractors or Distributors nameplates shall not be fixed to items of equipment and are not an acceptable alternate to the manufacturer's nameplate data.

D. No materials or equipment used shall be discontinued or about to be discontinued items.

E. The Engineer shall have the right to reject any part of the work in case the material or workmanship is not of satisfactory quality. Any work or material deemed unacceptable by the Engineer shall be removed and replaced with acceptable work and material as defined by the Engineer, and at no additional expense to the Owner.

2.2 PROTECTION:

A. Work performed by the Contractor shall include protecting the work and materials of all other Contractors from damage by work or workmen, and shall include making good any and all damage thus caused.

B. The Contractor shall be responsible for work and equipment until finally inspected, tested and accepted. Protect work against theft, weather, injury or damage, and carefully store material and equipment received on site which is not immediately installed. Close open ends of work with approved covers, caps or plugs during construction to exclude dust, dirt, moisture, plaster, mortar, or general construction debris. Note - duct tape is not an acceptable means of protecting open conduit and pipe ends.

C. If so specified, work may include receiving, unloading, uncrating, storing, protecting, setting in place and completely connecting any motor starters and/or control equipment having mechanical/electrical service connections which may be furnished by Owner or furnished by others.

D. Work shall include exercising special care in handling and protecting equipment and fixtures. Any equipment and fixtures which are missing, lost, stolen, or damaged by reason of the Contractor's failure to provide adequate protection shall be replaced by that Contractor at no additional cost to the Owner.

2.3 TEMPORARY FACILITIES:

A. Provide temporary power, lighting, and communications as required for the performance of the work of this Contract.

B. Provide new materials and equipment; if acceptable to the Engineer, undamaged previously used materials in serviceable condition may be used. All materials shall be suitable for the service intended.

C. Maintain temporary services and facilities in a neat and clean manner. Operate in a safe and efficient manner. Do not allow hazardous, dangerous, or unsanitary conditions to develop or persist on site.

D. Do not overload temporary facilities, or permit them to interfere with progress of the work.

E. Scaffolding and other temporary construction shall be rigidly built in accordance with Local, State, and Federal regulations.

F. Remove each temporary facility when no longer needed, when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete and/or restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged work, clean exposed surfaces, and replace construction that cannot be repaired to the satisfaction of the Owner.

2.4 SCAFFOLDING, RIGGING, HOISTING:

A. Work shall include all scaffolding, rigging, hoisting and services necessary for delivery and erection of equipment into or onto the site and/or building. Remove all scaffolding, rigging, and hoisting equipment from the site when no longer needed.

2.5 EXCAVATION AND BACKFILLING:

A. Excavation and backfilling for all electrical work inside and outside of the building shall be performed in accordance with Division 2 of these Specifications.

2.6 CUTTING AND PATCHING:

A. Cutting and patching for all electrical work shall be performed in accordance with Division 1of these Specifications.

2.7 SLEEVES AND OPENINGS:

A. The Electrical Contractor shall provide all necessary sleeves and openings as required to permit the installation of the electrical systems.

2.8 PAINTING:

A. All painting of electrical work shall be performed in accordance with Division 9 of these Specifications, unless otherwise specified.

2.9 ELECTRICAL MOTOR STARTERS AND VARIABLE FREQUENCY DRIVES (VFD'S):

A. Motor starters and variable frequency drives (VFD'S) shall be furnished by each respective trade for motor driven equipment provided by them. The Electrical Contractor shall install the starters and VFD'S, and shall provide all power wiring to the starters and VFD'S, and from the starters and VFD'S to the motors they control.

B. Motor starters and VFD'S shall conform to requirements of NEC, NEMA, UL, CSA, and ANSI and shall be suitable for the required horsepower, duty, voltage, phase, frequency, service, and location. All starters and VFD'S shall be furnished in NEMA enclosures suitable for the environment in which they are to be located.

C. All starters shall be of the same manufacture and shall be furnished in Square D, Eaton (Cutler-Hammer), or Allen Bradley.

D. Thermal Overloads:

1. All motors 1/8 horsepower or larger shall be provided with thermal-overload protection. Thermal overloads shall be melting alloy ambient temperature compensating type.
2. Thermal overloads shall be sized in accordance with NEC requirements for the nameplate data of the motor(s) as actually delivered to the site.

E. Starters for manual control of single phase motors up to one (1) horsepower furnished without integral thermal overloads shall be combination manual disconnect switch and

starters with thermal overload protection for each ungrounded leg. Starters shall be inoperable if a thermal unit is removed. These starters shall be 2-pole and shall be provided with green neon pilot light and handle guard/lock-off.

E. Starters for three phase motors shall be full voltage, circuit breaker combination magnetic starters. All circuit breaker combination magnetic starters shall include melting alloy type thermal overload protection, low voltage protection, and two (2) sets of auxiliary normally open and normally closed contacts. Thermal overload protection shall be provided in each ungrounded leg. Starters shall be inoperable if a thermal unit is removed. All circuit breaker combination magnetic starters shall be equipped with control power circuits. Provide starters with control power transformers of secondary voltage required for the control power circuitry. Provide control power transformers with primary and secondary fusing. The disconnect handle on circuit breaker combination magnetic starters shall always be in control of the disconnect device with the door opened or closed. The disconnect handle shall be clearly marked as to whether the disconnect device is "on" or "off", and shall include a two-color handle grip, the black side visible in the "off" position, and the red side visible in the "on" position.

1. All circuit breaker combination magnetic starters for manual control of three phase motors shall have start-stop push buttons in the cover and shall be provided with red and green pilot lights.
2. All circuit breaker combination magnetic starters for automatic or interlocking control of three phase motors shall have hand-off-automatic selector switches in the cover and shall be provided with red and green pilot lights.

2.10 BASES AND SUPPORTS:

A. Provide all necessary supports, rails, framing, bases, and piers required for the installation of equipment provided under this contract.

B. Unless otherwise shown, all equipment shall be securely attached to the building structure in an acceptable manner. Attachments shall be of a strong and durable nature; any attachments that are insufficient in the opinion of the Engineer shall be replaced as directed at no additional cost to the Owner.

2.11 SEISMIC RESTRAINTS:

A. Provide seismic restraints for all electrical system components in accordance with the 2016 Connecticut State Building Code.

2.12 SLEEVES, INSERTS AND ANCHOR BOLTS:

A. The Contractor shall provide and shall be held responsible for the location and position of all sleeves, inserts, and anchor bolts required by his work. Failure to do so, which requires cutting and patching of finished work, shall be done at no additional cost to the Owner.

2.13 FIRE STOPPING:

A. Fire stopping work shall be done under Division 7 of these specifications.

2.14 LUBRICATION:

A. All equipment installed under this contract having moving parts shall and requiring lubrication shall be properly lubricated according to the manufacturer's instructions prior to operation and testing. Any such equipment discovered to have been operated prior to lubrication by the Contractor shall be subject to rejection and replacement at no additional cost to the Owner.

2.15 ACCESS PANELS:

A. Provide access panels for electrical equipment which is not readily accessible. Such equipment includes items above hung ceilings which are not readily removable and items installed within walls, inside chases, or inside dead cavity spaces.

B. Access panels shall be of sufficient size to permit easy replacement and servicing of electrical equipment.

C. Access panels shall bear the same or greater fire rating as the wall or ceiling in which they are installed.

2.16 OTHER MATERIALS:

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

B. Provide miscellaneous hardware and support accessories, including channels, support rods, nuts, bolts, screws, and other such items, with galvanized or cadmium plated finish, or other approved rust inhibiting coatings.

PART 3 - EXECUTION

3.1 GENERAL:

A. Unless specifically noted or shown otherwise, install all equipment and material specified herein or shown on drawings whether or not specifically itemized herein.

3.2 SURFACE CONDITIONS:

A. Examine the areas and conditions under which work of this Contract will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.3 DEMOLITION AND REMOVALS:

A. Existing electrical systems, equipment, and wiring shall be demolished and removed as shown on the drawings and as specified herein.

B. The demolition drawings are an accommodation to the Contractors to show general intent of the scope of the demolition work. However, it is incumbent on the various Contractors to visit the job prior to bidding to determine the exact amount of demolition work he is responsible for. If

clarification is not requested prior to bidding on any item, it is assumed the scope is understood and all required demolition work will be performed whether or not same is shown on the drawings.

C. Any asbestos removal work required shall be done under a separate contract.

D. Disconnect, remove, and/or relocate existing electrical work as noted on the plans, as required for the performance of the work of this contract, and as required for coordination of the work between trades.

E. Remove all demolition material from the job site unless the owner requests to retain any such material for his own use. Any material that is requested by the Owner to be retained shall be delivered to the Owner's designated storage area on site.

3.4 PREPARATION:

A. Coordinate:

1. Coordinate as necessary with other trades to assure proper and adequate provisions in the work of those trades for interface with the work of this Contract. Each Contractor shall furnish all information necessary to permit work of other trades to be installed in a satisfactory manner.

2. Coordinate delivery of equipment to project prior to installation. Any equipment stored for an extended period of time prior to installation may be subject to rejection by the Owner or Engineer.

3. Coordinate the installation of items with the schedule for work of other trades to prevent unnecessary delays in the total work.

4. Where electrical equipment is shown in conflict with locations of structural members or other equipment, provide required supports, offsets, bends, or tees as required to clear the encroachment.

5. No conduit, cable(s), boxes, etc., shall be installed until the entire run has been checked for clearances and the work has been coordinated between all the trades. Each tradesman shall be responsible for taking his own field measurements and maintaining proper clearance from the Owner's equipment and the work of other trades, and for coordinating his work with that of other Contractors. Furnish all necessary information, dimensions, templates, etc. in order that a properly coordinated job will result.

6. Prior to roughing, the contractor shall obtain exact electrical equipment, fixture, and device locations from the Owner. Equipment, fixture, and device locations shown on the drawings are to be used for general reference only. Roughing of equipment, fixtures, and devices shall not proceed until the exact locations, heights, and orientations of same have been agreed upon with the Owner.

7. If due to lack of coordination and foresight by the Contractor, equipment must be relocated or extra work performed, all costs shall be the responsibility of the Contractor and may not be passed through to the Owner.

B. Unload equipment and materials delivered to the site. Pay cost for rigging, hoisting, lowering and moving electrical equipment on site, in building, or on roof. During construction provide protection against moisture, dust accumulation, and physical damage of equipment, Provide temporary heaters within units as required to evaporate excessive moisture and provide ventilation as required.

C. Certain present building clearances are available for handling equipment. All equipment shall be delivered knocked down as required to clear space limitations on site and within the building.

D. Unless noted otherwise the Contractor shall set all equipment level, plumb, and secure prior to making connections to other equipment or systems.

E. Data indicated on the drawings and in these Specifications are as exact as could be secured, but their absolute accuracy is not warranted. The exact locations, distances, levels and other conditions will be governed by actual construction and the drawings and specifications should be used only for guidance in such regard.

F. Verify all measurements at the building. No extra compensation will be allowed because of differences between work shown on the drawings and actual measurements at the site of construction.

G. The drawings are diagrammatic, but are required to be followed as closely as actual construction and work of other trades will permit. Where deviations are required to conform with actual construction and the work of other trades, make such deviations without additional cost to the Owner.

3.5 ACCESSIBILITY:

A. Locate all equipment which must be serviced, operated or maintained, in fully accessible positions including but not limited to: controllers, motor starters, disconnect switches, transformers, panelboards, switchgear, etc. Provide access panels as required for equipment access.

B. Failure by the Contractor to locate equipment and arrange the installation to allow for adequate access and clearance for maintenance and servicing shall result in rejection of the installation and the disassembly, relocation and re-assembly of the installation shall be done by the Contractor at no additional cost to the Owner.

3.6 CLEANING AND PROTECTING PIPING, CONDUITS AND EQUIPMENT:

A. Thoroughly clean all piping, conduit, and equipment of all foreign substances inside and out before installation.

B. Plug open pipe and conduit ends during construction with approved plugs or caps to exclude dust, moisture, plaster or mortar etc. Note - using duct tape to cover conduit and pipe ends is not an acceptable means of excluding construction debris and may result in rejection of the installation with remedial action to be taken by the Contractor at no additional cost.

C. If any part of a conduit system should be blocked by any foreign matter after being placed

in operation, the system shall be disconnected, cleaned and reconnected wherever necessary in order to locate and remove the obstruction(s). Any work damaged in the course of removing obstructions shall be repaired or replaced at no additional cost to the Owner.

3.7 TESTING AND INSPECTION:

A. Provide personnel and equipment, make required tests, and secure required approvals from governmental agencies having jurisdiction.

B. When material and/or workmanship is found to not comply with the specified requirements, within three days after receipt of notice of such non-compliance remove the non-complying items from the job site and replace them with items complying with the specified requirements, all at no additional cost to the Owner.

C. Perform all required adjustments and settings. Verify and correct any deficiencies as required.

D. Provide all necessary testing equipment.

E. In the Owner's Presence:

1. Test all parts of the electrical system and prove that all such items provided under this Specification function electrically in the required manner.

3.8 PROJECT COMPLETION:

A. Upon completion of the work, remove all waste, rubbish and other materials left as a result of operations and leave the premises in clean condition.

B. Thoroughly clean all exposed portions of the mechanical and electrical installations, removing all traces of soil, labels, grease, oil and other foreign material, and using only the type cleaner recommended by the manufacturer of the item being cleaned.

C. Vacuum all exteriors of equipment and interiors of equipment having accessible interior compartments to remove all dust, dirt, cable clippings, construction debris, etc.

D. Equipment with damage to painted finish shall be repaired to satisfaction of the Owner.

E. Upon completion of all work and of all tests, the Contractor shall furnish the necessary skilled labor and helpers for operating the system and equipment for a period of one (1) day or eight (8) hours, or as otherwise specified. During this period, instruct the Owner or his representative fully in the operation, adjustment and maintenance of all equipment furnished. Give at least forty-eight (48) hours' notice to the Owner in advance of this period.

F. Thoroughly indoctrinate the Owner's operation and maintenance personnel in the contents of the record drawings and the operations and maintenance manual required to be submitted under these Specifications.

3.9 INSTRUCTION PERIOD:

A. Prepare written instruction frames for the proper maintenance and operation of any special equipment furnished and installed under this Contract.

B. The contractor shall arrange for on-site instruction of the Owner's representatives by manufacturers of all major items of equipment. The instruction periods shall be consecutive and shall be held after the installations are complete, tested and balanced and the approved documentation is available. The contractor shall be responsible for attendance of the manufacturer's technical representatives and shall coordinate program timing with the Owner.

C. In addition to normal operation, the Owner's representatives shall be instructed on routine maintenance and trouble-shooting.

END OF SECTION 26 00 00

SECTION 26 05 00 - BASIC ELECTRICAL MATERIALS & METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The Bidding Requirements, Contract Forms and Conditions of the Contract, including General Conditions of the Contract for Construction, and Division 1 - General Requirements, apply to the work specified in this Section.

B. Sections 200050 General Conditions, and 260000 General Electrical, shall also govern the work under this Section.

C. This Section includes requirements that are binding on other Sections of Division.

D. Examine all drawings, data, and coordinate the work of this Section with all related and adjoining work.

1.2 SCOPE:

A. Scope of work consists of installation of materials to be furnished under this Section, and without limiting generality thereof consists of furnishing labor, materials, equipment, hoisting, plant, transportation, rigging, staging, appurtenances, and services necessary and/or incidental to properly complete all electrical work as shown on the drawings, as described in these specifications or as reasonably inferred from either as being required in opinion of the Owner.

B. Work Included: Provide complete electrical services where shown on the drawings, as specified herein and as needed for a complete and proper installation including but not necessarily limited to:

1. General
2. Conduits & Raceways
3. Equipment Labeling
4. Wire and Cables
5. Receptacles
6. Outlet Boxes, Junction Boxes, Pull Boxes
7. Cabinets
8. Disconnect Switches
9. Supporting Devices
10. Panelboards
11. Circuit Breakers
12. Grounding
13. Backboards

1.3 QUALITY ASSURANCE:

A. Refer to Section 260000.

1.4 SUBMITTALS:

A. Shop Drawings: Submit for all items listed in Paragraph 1.2.B.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Provide only materials that are new and of type and quality specified, or approved equal. Where Underwriters' Laboratories, Inc. have established standards for such materials, provide only materials bearing the UL label.

B. Provide materials and equipment necessary to make installation complete in every detail, and to conform to manufacturers' latest installation instructions, under this contract whether or not specifically shown on drawings or specified herein.

2.2 TEMPORARY FACILITIES:

A. Refer to the requirements of Division 1 regarding temporary facilities.

B. Scaffolding and other temporary construction shall be rigidly built in accordance with Local and State requirements. Remove from premises upon completion of work.

C. Provide temporary construction required for electrical work as directed by the Engineer.

2.3 RACEWAYS:

A. Rigid Steel Conduit:

1. Shall be manufactured from high strength strip steel, shall be hot dipped galvanized with threads galvanized after cutting, and shall be chromated to form an additional protective layer. Rigid steel conduits shall be UL listed, shall meet the requirements of ANSI C80.1, and shall be as manufactured by Allied Tube and Conduit, Wheatland, or Calconduit.
2. Shall be used in outdoor locations where conduit is exposed to physical damage, sunlight or weather.
3. Shall be used for underground work.
4. Shall be used for horizontal and vertical underground sweeps, horizontal and vertical sweeps below concrete slabs, and for penetrations through concrete slabs.
5. Fittings, couplings and connectors shall be threaded and galvanized or cadmium plated.

B. Rigid PVC Conduit:

1. Shall be heavy wall schedule 40 PVC for underground work and extra heavy wall schedule 80 PVC for underground work below vehicular traffic areas. Joints and fittings shall be solvent welded all to ASTM standards for underground installation and in accordance with Article 352 of the National Electric Code.

2. May be used in lieu of rigid steel conduit for underground work except as noted in paragraph 2.3, A, 4 above.
3. The minimum size for running below slabs shall be 1 1/4" for both feeders and branch circuits.
4. Joints shall be made watertight.
5. Shall not be embedded in concrete slabs.
6. Shall not be used above ground.
7. Shall not be used for underground horizontal and vertical sweeps, horizontal and vertical sweeps below concrete slabs, or for penetrations through concrete slabs.
8. Furnish conduit system in Prime, Cantex, or JM Eagle.
9. Flexible PVC conduit (ENT) shall not be used.

C. Intermediate Steel Conduit:

1. Shall be manufactured from high strength flat steel that is cold-formed and electrically welded into a uniform tube, shall be hot dipped galvanized with threads galvanized after cutting, and shall be chromated to form an additional protective layer. Intermediate steel conduit shall be UL listed, shall meet the requirements of ANSI C80.6, and shall be as manufactured by Allied Tube and Conduit, Wheatland, or Calconduit..
2. Shall be used in interior locations where conduit is exposed to physical damage, or corrosive or wet environments.
3. Fittings, couplings and connectors shall be threaded and galvanized or cadmium plated.

D. Electrical Metallic Tubing:

1. Shall be manufactured from high grade mild strip steel, shall be hot dipped galvanized, and shall be chromated and lacquered to form additional protective layer. EMT conduit shall conform to UL 797 and ANSI C80.3 and shall be as manufactured by Allied Tube and Conduit, Wheatland, or Calconduit.
2. Connectors and couplings shall be galvanized steel set screw type. Provide gland compression type couplings and connectors for exposed work in wet locations.
3. Shall be used for all interior feeders except where noted differently on the drawings. Provide insulated throat grounding bushings for all feeder conduit connections to switchboards, panelboards, disconnect switches, wireways, and pull boxes.
4. Shall be used for all interior wiring in masonry partitions, above non-accessible ceilings, and where exposed to view.
5. Shall be used for all branch circuit homeruns and closing connections to panelboards. Do not use Type 'MC' cable for wiring exposed to view, in masonry partitions, above non-accessible ceilings, or for branch circuit homeruns.
6. Shall be used for all branch circuits feeding HVAC equipment and equipment requiring 3-Phase power.
7. Shall not be embedded in concrete slabs.

E. Flexible Steel Conduit:

1. Shall be full wall steel flexible conduit, shall be manufactured from high grade strip steel and shall be hot dipped in a molten zinc bath. The steel strip shall be

formed into interlocking convolutions that are continuously joined, metal to metal, assuring continuous grounding contact. Flexible steel conduit shall be UL listed and shall be as manufactured by AFC Cable Systems, Greenfield, Anaconda, or Electri-Flex.

2. Flexible steel conduit fittings shall be zinc plated malleable iron squeeze type connectors and zinc plate malleable iron combination couplings
3. May be used in short lengths where EMT cannot be installed due to interferences and obstacles.
4. Provide for final connections to motor driven equipment, transformers, recessed light fixtures, chain hung light fixtures, or where subject to vibration.

F. Liquidtight Flexible Steel Conduit:

1. Shall be similar to flexible steel conduit, but with pressure-extruded moisture and oil-proof outer jacket of gray polyvinyl chloride plastic. Liquidtight flexible steel conduit shall be UL listed (UL 360) and shall be as manufactured by AFC Cable Systems, Anaconda, or Electri-Flex.
2. Fittings, couplings and connectors shall be threaded, zinc plated, malleable iron liquidtight type.
3. Provide where located outdoors or in damp or wet areas for final connections to motor driven equipment, or where subject to vibration.
4. Do not use in environmental air plenum spaces.

G. Sleeves:

1. Provide EMT sleeves for each conduit and cable passing through interior walls, partitions, and floors.
   a. Set pipe sleeves in place before wall, floor, or partition is finished.
   b. Support conduit and cable free from sleeves.
   c. Provide sleeves two pipe sizes larger than the conduit or cable passing through, or provide a minimum of ½" clearance.
2. Provide chrome plated escutcheon plates for each sleeve where exposed to view in finished areas.
3. Provide GPT Industries WSG galvanized steel wall sleeves for each conduit passing through foundation walls. Galvanized steel wall sleeves shall be schedule 40 steel pipe in sizes through 10" diameter and shall have a 0.375" wall thickness for sizes 12" diameter and larger. WSG galvanized steel wall sleeves shall have a 2" collar (water stop) at the mid-point of the sleeve. The 2" collar shall be continuously welded on both sides to the sleeve. Provide GPT Industries Link-Seal modular waterproof seals at all foundation wall sleeves. Where penetrating existing foundation walls provide a core drilled penetration and Link-Seal modular waterproof seal without the galvanized steel wall sleeve.

H. Surface Steel Wireway:

1. Wireways shall be code gauge galvanized steel, manufactured standard sections and fittings, with hinged and/or screw covers, indoors NEMA Type 1/Outdoors NEMA Type 3R, and shall be manufactured by Hoffman, Cooper, Square D, or Wiremold. Wireways shall be sized to code conductor fill requirements and shall be provided as required for job conditions.

2.4 METHODS AND MATERIALS FOR LABELING EQUIPMENT:

A. Panelboards, Safety Switches:

1. Non-metallic engraved nameplates shall be used to identify device. Nameplates shall be secured to equipment with two screws or rivets.
2. Letters to be white on black background.
3. Nameplate letters to be 1/4" high.
4. Identification nomenclature shall be in accordance with plans. All name nomenclature shall be submitted for approval.

B. Identify all fused disconnect switches with installed fuse size, i.e: Maximum fuse size = xxx amps. Identification shall be of the same method as specified in paragraph 2.4.A, except white letters on red background.

C. Identify the covers of all junction boxes and pull boxes installed above ceilings and in unfinished spaces with branch circuit or feeder designations. Identification shall be done with black felt tip permanent marker in a neat and readily legible manner.

D. Provide a typewritten adhesive label with an identification legend at the switchboard and at each panelboard identifying the color coding of the ungrounded conductors being supplied by the switchboard and each panelboard.

E. Indexing and Identification: After installations are complete, provide and mount under sturdy transparent shield in the directory frame of each panel door a neat, accurate and carefully typed directory properly identifying the lighting, receptacles, outlets, equipment and rooms which each branch circuit breaker controls.

2.5 SAFETY SWITCHES:

A. All safety disconnect switches shall be furnished in heavy duty quick-make, quick-break, interlocking fusible or non-fusible, type as indicated on the drawings. Manufacturer shall be the same as provided for switchgear and panelboards.

B. Provide enclosures clearly marked for maximum voltage, current and horsepower rating, and:

1. Indoors: NEMA Type 1.
2. Outdoors or Damp or Wet Locations: NEMA Type 3R.
3. Hosedown and Splashing Water Locations: NEMA Type 4.

C. Furnish and install disconnect switches at each motor location except where combination switches and starters are furnished with equipment by others but are mounted by this contractor.

D. Furnish and install weatherproof disconnect switch at each exterior located fan or motor location.

E. Disconnect switches shall be of "lock-out" design to prevent opening of switch when in "ON" position.

2.6 MOTOR STARTER/DISCONNECTS AND VFD'S:

A. Combination motor starter/disconnects and variable frequency drives (VFD's) will be supplied by other trades for motor driven equipment provided by them.

B. The electrical contractor shall install the starter/disconnects and VFD's, and shall provide all power wiring to the units and from the units to the motors they control.

2.7 CONDUCTORS:

A. Conductors shall be provided in Cerro Wire Manufacture or comparable product in Republic Wire or General Cable.

B. All feeder conductors shall be copper rated 600 volts, 90 deg. C., dry and wet locations, Type XHHW-2, color coded.

C. All branch lighting and power conductors shall be copper rated 600 volts, 90 deg. C., dry and wet locations, Type XHHW-2, color coded.

D. Grounding electrode conductors and bonding conductors shall be soft drawn copper, ASTM B3 solid bare copper for sizes smaller than #8AWG, ASTM B8 concentric stranded bare copper for sizes #8AWG and larger.

E. Minimum gauge conductors shall be #12 AWG. Increase to #10 AWG for runs exceeding 75'-0", and #8AWG for runs exceeding 150'-0".

F. Wire Size #8 AWG and larger shall be stranded. Wire of size smaller than #8 AWG shall be solid.

G. Wire and cable conductors shall be soft drawn copper with conductivity of not less than 98 percent of ANSI Standard for annealed copper. Aluminum conductors shall not be used.

H. Type 'MC' Cable:

1. Shall be a factory assembly of copper type 'THHN' conductors including a green insulated equipment grounding conductor, with a mylar tape overall assembly covering, housed in a continuous interlocking galvanized steel sheath. Provide with optional insulated bushings.
2. May only be used in dry locations for single phase receptacle branch circuit wiring where concealed from view above accessible ceilings or in stud walls.
3. Shall not be used in damp or wet locations, where exposed to view, in masonry walls, above non-accessible ceilings, for HVAC equipment, for equipment requiring 3-phase power, for branch circuit homeruns, or for closing connections to panelboards.
4. Shall be as manufactured by AFC Cable Systems, Southwire, or CME.
5. Metal clad cable connectors shall be malleable iron set screw type connectors.

2.8 OUTLET, JUNCTION AND PULL BOXES:

A. Provide outlet boxes as required for a complete installation.

B. Outlet boxes shall be code gauge galvanized steel and shall be of shapes and sizes to suit their respective locations and installations, and shall be provided with covers to suite their function and installation. Outlet boxes shall be equipped with fixture stud or straps where required.

C. The minimum box size for all wall mounted outlet boxes shall be nominal 4" square x 2 1/8" deep (2-gang) except where noted differently on the drawings. Provide larger size outlet boxes, or gangable type boxes where required for the installation.

D. For exposed work, provide drawn-type boxes with galvanized steel crushed corner exposed work covers. Provide cast boxes for work exposed to wet locations and where called for on the drawings.

E. For above ground pull boxes, provide galvanized code-gauge sheet steel units with screwed on covers, of size and shape required to accommodate wires without crowding, and to suit the location. Provide pull boxes as specified herein, as required for job conditions, and as follows:

1. Indoors: NEMA Type 1.
2. Outdoors or Damp or Wet Locations: NEMA Type 3R.
3. Hosedown and Splashing Water Locations: NEMA Type 4.

2.9 WIRING DEVICES:

A. All devices shall be furnished in Hubbell or comparable product in Cooper or Leviton. Devices specified herein are based on Hubbell unless otherwise noted. Device colors shall be as directed by the Engineer.

B. Receptacles:

1. Single and duplex convenience receptacles shall be heavy duty specification grade, 2 pole, 3 wire grounding, NEMA 5-20R, rated 20AMP at 125 Volts AC. Receptacles shall have a one-piece all brass wrap around mounting strap with integral ground contacts and ground tension retaining clips, tandem bypass contact, heat resistant thermoplastic rynite base, and high impact nylon face. Receptacles shall be back and side wired, shall have a back wired green ground terminal, automatic ground clip, and threaded brass square head center rivet assembly.

Single Receptacle #HBL5361
Duplex Receptacle #HBL5362WR

2. Ground Fault Duplex convenience receptacles shall be heavy duty specification grade, 2 pole, 3 wire grounding, NEMA 5-20R, rated 20AMP at 125 volts AC. Receptacles shall have a solid brass wrap around mounting strap with pre-tensioned ground contacts, tandem modified bypass contacts, all glass circuit board with conformal coating for superior moisture immunity, 7 noise filtering

capacitors, heat resistant thermoplastic base and high impact nylon face. Receptacles shall be back and side wired and shall have a green ground terminal.

Duplex GFCI Receptacle #GFR5362SG

3. Weatherproof enclosures for outdoor GFCI receptacles shall be cast aluminum, single gang vertical Hubbell #WP26M or single gang horizontal Hubbell #WP26MH. Enclosures shall include gasket and mounting screws, shall have ¼" diameter padlock holes, and shall have large cord openings for use with cover closed.

2.10 PANELBOARDS:

A. Panelboards shall be furnished in Cutler-Hammer manufacture or approved equal in Square D.

B. Panelboards shall be equipped with the following features:

1. Bolt-on circuit breakers.
2. Symmetrical interiors.
3. Surface or flush trim as called for in schedule, door-in-door type.
4. Flush key catch lock.
5. Painted finish, ANSI-61 gray.
6. Metal frame/plastic cover index card holder.
7. Separate equipment ground bus.
8. Fast latch trim and jacking screw adjustment.
9. Split neutral.
10. Connection accessible from front.
11. Copper lugs (feeder cable connectors).
12. 1000 amps per square inch density rated silver-plated copper busses.
13. Copper ground bar.
14. Black face/white core engraved nameplate fixed to panel w/ two screws or rivets.

C. Indexing and Identification: After installations are complete, provide and mount under sturdy transparent shield in the directory frame of each panel door a neat, accurate and carefully typed directory properly identifying the lighting, receptacles, outlets, equipment and rooms which each branch circuit breaker controls.

D. All circuit breakers feeding mechanical equipment shall be 'HCAR' rated.

E. Circuit breakers shall be bolt-on type with short circuit interrupting rating as indicated in panel schedule.

F. Circuit breakers shall be provided with copper line and load lugs (cable connectors).

G. 20 Amp, 1-Pole circuit breakers shall be listed by the Manufacturer for use with #12AWG through #8AWG conductor sizes.

2.11 FUSES:

A. Provide current limited, non-renewable fuses, Bussman, Littelfuse, or Gould, UL class J up to 600 Amp and Class L over 600 Amp.

B. Fuses shall be rated 600V or less A.C., UL listed, and have minimum interrupting rating of 200,000 rms amperes with peak let-through current and maximum clearing values within prescribed UL limits. Fuses for motor feeders or motor circuits shall be Class RK-5 of voltage classification rated for motor with minimum interrupting capacity of 200,000 rms amperes and with minimum time delay of ten seconds at 500%.

2.12 BACKBOARDS:

A. Backboards shall be constructed of fire retardant plywood sheets, 4' x 8' x ¾".

1. Paint backboards on all sides with two coats of light gray fire-resistant paint prior to mounting equipment.

2. Mount backboards on unistrut channel supports.

B. Provide backboards where indicated on the drawings and for mounting all surface mounted electrical panelboards.

2.13 ACCESS PANELS:

A. Provide access panels for electrical equipment and wiring splices which are not readily accessible. This includes electrical equipment and wiring splices installed above hung ceilings which are not readily removable, within walls, inside chases, or inside dead cavity spaces.

C. Access panels shall be prime painted steel, with screwdriver lock, shall bear the same fire rating as the wall or ceiling in which they are installed, and shall be of sufficient size for wiring splice access or electrical equipment removal and replacement. Access panels shall be provided in Milcor manufacture, or approved equal. Provide Milcor Type A in acoustical tile surfaces, Type K for plastered surfaces, and Type M for masonry construction.

2.14 OTHER MATERIALS:

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the contractor subject to the approval of the engineer.

PART 3 - EXECUTION

3.1 GENERAL:

A. Unless specifically noted or shown otherwise, install all equipment and material specified herein or shown on drawings whether or not specifically itemized herein. PART 3 covers particular installation methods and requirements peculiar to certain items and classes of materials and equipment.

B. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until satisfactory conditions are corrected.

C. The electrical drawings are diagrammatic, but are required to be followed as closely as actual construction and work of other trades will permit. Where deviations are required to conform with actual construction and the work of the other trades, make such deviations without additional cost to the Owner.

D. Data indicated on the drawings and in these specifications are as exact as could be secured, but their absolute accuracy is not warranted. The exact locations, distances, levels and other conditions will be governed by actual construction and the drawings and specifications should be used only for guidance in such regard.

E. Verify all measurements at the building. No extra compensation will be allowed because of differences between work shown on the drawings and actual measurements at the site of construction.

F. Do not scale drawings. Scale indicated on drawings is for establishing reference points only. Actual field conditions shall govern all dimensions.

G. Coordinate:

1. Coordinate as necessary with other trades to assure proper and adequate provisions in the work of those trades for interface with the work of this Section.
2. Coordinate delivery of electrical equipment to project prior to installation. Equipment stored for an extended period of time prior to installation may be subject to rejection by Architect.
3. Coordinate the installation of electrical items with the schedule for work of other trades to prevent unnecessary delays in the total work.
4. Where electrical items are shown in conflict with locations of structural members and mechanical or other equipment, provide required supports and wiring to clear the encroachment.
5. Prior to roughing, the contractor shall obtain exact fixture and device locations from the Owner. Outlet and fixture locations shown on the drawings are to be used for general reference only. Roughing of fixtures and outlets shall not proceed until exact locations, heights, and orientations of fixtures and outlets have been agreed upon with the Owner.
6. Arrange installation to provide access to equipment for easy maintenance and repair.

3.2 INSTALLATION OF RACEWAYS AND FITTINGS:

A. Install wire and cable in approved raceways as specified and as approved by authorities having jurisdiction.

B. All conduits shall be concealed from view above ceilings, in chases, and in walls. Conduits may only be installed exposed to view in mechanical and electrical rooms and where run overhead in rooms without ceilings

C. Run conduit and cable parallel to or at right angles with lines of the building, to present a neat appearance.

1. Make bends with standard conduit elbows or conduit bent to not less than the same radius.
2. Make bends free from dents and flattening.

D. Provide code sized conduit unless a larger size is shown on the drawings or specified herein. Minimum size shall be ¾" diameter.

E. Securely and rigidly support conduit and MC cable throughout the work with approved conduit clips and hangers all in conformance with code seismic requirements.

1. Do not use mechanics wire for supporting conduit or MC cable.
2. Do not support conduits on hung ceilings or from mechanical or electrical equipment.
3. Steel supports and racks shall be galvanized steel channel and fittings, unistrut or approved equal.
4. Provide clamps and support rods as required.
5. Steel support rods or support bolts for conduits shall be 1/8 inch diameter for each inch or fraction thereof of diameter of conduit size, but no rod or bolt shall be less than ¼" in diameter.
6. Horizontal and vertical conduit supports shall not be more than 10' apart or more than 1' from any fitting.
7. Install conduit and MC cable so it is not in contact with, or resting on, plumbing, fire protection, or HVAC equipment, piping, or ductwork.

F. Do not install conduit runs exposed on the building exterior.

G. Maintain at least 3" clearance between conduits and heating pipes when running parallel to these pipes, and at least 1" clearance when running perpendicular to these pipes.

H. Provide double locknuts on all conduits terminating in sheet metal enclosures. Provide grounding bushings on all feeder conduits.

I. Provide expansion couplings for rigid metallic and non-metallic conduits where such conduits are subject to thermal expansion and contraction. Provide combination deflection/expansion couplings for metallic and non-metallic conduits where such conduits cross through building expansion joints.

J. Provide full wall steel flexible conduit for all conduit penetrations through fire walls. Full wall steel flexible conduit shall be 3-hour through penetration fire wall rated.

K. Install link-seal waterproof seals around all conduit penetrations through basement walls, floors, or foundation walls.

L. Where conduit is installed underground or is exposed to weather or wet areas make all joints watertight. Seal all site work open conduit ends containing conductors water tight. Cap all site work open conduit ends that do not contain conductors.

M. Provide necessary sleeves and chases where conduits and cables pass through floors, walls, ceilings, and roofs, and provide other necessary openings and spaces, all arranged for in proper time to prevent unnecessary cutting. Perform cutting and patching in accordance with the provisions for the original work.

N. Provide offsets prior to entrance into outlet boxes and other electrical equipment for proper adjustment to finished building surfaces. Exercise care when roughing-in conduits which turn up or down to surface mounted panelboards or cabinets, so that conduit extensions to cabinet will be fitted close to wall. Where possible, provide back entry into surface mounted boxes or equipment items.

O. Install rigid galvanized steel conduit with ends cut square without sharp edges, threaded, and I.D. reamed to remove any burrs. Field made bends shall be of equivalent radius as factory made bends. Exposed threads shall be kept to a minimum.

P. Seal around all conduit and cable penetrations through fire rated walls and ceilings with 3M Brand CP25N/S fire barrier caulking.

Q. Carefully clean and dry all conduit before installation of conductors. Do not pull wires into conduit system until building roof and walls are weather-tight and all rough plastering is completed. Provide Prime conduit plugs and end caps to exclude dust, moisture, plaster, or mortar while building is under construction.

R. Lubricants or cleaning agents which might have deleterious effect on conductor coverings shall not be used for drawing conductors into raceways.

S. Provide minimum 3/16 inch diameter twisted nylon fish cord in all empty raceways. Provide tag on each end indicating location of other end. Fish cord shall have minimum of 200 pounds tensile strength.

T. All wiring shall be installed in electrical metallic tubing unless otherwise specified herein or called for on the drawings.

1. Where conduit is installed underground (buried), provide PVC conduit.
2. Where conduit is installed embedded in cinder concrete, provide rigid galvanized steel conduit.
3. Provide intermediate steel conduit for exposed conduit installed below 7 feet in areas such as mechanical rooms, or where subject to physical abuse.
4. Use flexible conduit for final connections to motor driven equipment, recessed light fixtures, transformers, or where subject to vibration. Where such equipment is located in wet areas or exposed to weather use liquid-tight flexible conduit.
   Flexible connections shall be minimum of 18 inches and maximum of 6 feet long with grounding conductor. Flexible connections shall be used prior to attachment of conduit to equipment housing.

3.3 SLEEVES:

A. Provide EMT sleeves for each conduit and cable passing through interior walls, partitions, and floors.

1. Set pipe sleeves in place before wall, floor, or partition is finished.
2. Support conduit and cable free from sleeves.
3. Provide sleeves two pipe sizes larger than the conduit or cable passing through, or provide a minimum of ½" clearance.

B. Provide chrome plated escutcheon plates for each sleeve where exposed to view in finished areas.

C. Provide GPT Industries WSG galvanized steel wall sleeves for each conduit passing through basement walls or foundation walls. Galvanized steel wall sleeves shall be schedule 40 steel pipe in sizes through 10" diameter and shall have a 0.375" wall thickness for sizes 12" diameter and larger. WSG galvanized steel wall sleeves shall have a 2" collar (water stop) at the mid-point of the sleeve. The 2" collar shall be continuously welded on both sides to the sleeve. Provide GPT Industries Link-Seal modular waterproof seals at all foundation wall sleeves. Where penetrating existing basement or foundation walls provide a core drilled penetration and Link-Seal modular waterproof seal without the galvanized steel wall sleeve.

D. Caulk the space between sleeve and conduit or cable using 3M Brand OP25N/S fire barrier caulking.

E. Fireproof all penetrations made in fire rated walls or floors with UL approved materials to prevent passage of fire and smoke and maintain original fire rating of floors or walls.

3.4 CONDUCTOR INSTALLATION:

A. General:

1. The interior of all conduits shall be cleared of burrs, moisture, dirt and obstructions before wires are pulled.
2. Lubricant for pulling wires shall be inert to cable and conduit, shall not in any way restrict ease of pulling through conduit with passage of time, and shall be special lubricant designed specifically for cable pulling and shall be chemically compatible with cable.

B. Color Coding:

1. Consistent phase identification of all conductors shall be maintained as follows:

	120/208V	277/480V
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral Wire	White	Natural Grey

Provide colored plastic tape of specified color code identification for large size conductors available only in black. Wrap tape three complete turns around conductor, at ends and at connections and splices. Provide same color coding for switch legs as corresponding phase conductor.

C. Minimum Conductor Sizes:

1. The minimum branch circuit conductor size shall be #12AWG. Provide #10AWG conductors for branch circuits where the conductor run exceeds 75 feet, and #8AWG conductors where the conductor run exceeds 150 feet.

D. Provide the number of conductors required for a given branch circuit, or as required for circuitry, whether indicated on the drawings or not.

E. Neutral Conductors:

1. All branch circuits shall be installed with a separate neutral conductor. Shared neutrals for groups of branch circuits shall not be permitted.

F. Provide each circuit with a dedicated ground wire back to its respective panel ground bar. Size all ground wires in accordance with NEC requirements. Use #12 minimum size.

G. MC cable may only be used in dry locations for single phase lighting and receptacle circuits where concealed above hung ceilings or in stud walls. Homeruns shall be conductors in conduit. MC cable shall not be used in masonry partitions, above non-accessible ceilings, for branch circuit homeruns, or where exposed to view.

1. MC cable shall be supported from the building structure using hangers, clips, and approved plenum rated plastic ties. In lay-in ceiling areas the cable shall not rest on ceiling grid or tiles, and shall not be tied to the ceiling grid wire hanging system. Do not use mechanics wire for supporting or securing MC cable.

H. Identify conductors passing through pull boxes, junction boxes, and wireways to indicate circuit designation. Identify pull boxes and junction boxes as specified herein.

I. Phase conductors shall be connected to phase supply mains in proper rotation to assure balanced condition on panel. Circuit numbers assigned on drawings are for convenience only. Provide typed circuit directories for all panelboards at conclusion of work, representing circuits as actually connected to panelboard.

J. Branch circuit wiring and arrangement of home runs have been designed for maximum economy consistent with adequate sizing for voltage drops, circuit ampacities and other considerations.

1. Install the wiring with circuits arranged as shown on the drawings, except as otherwise approved in advance by the Architect and Engineer.
2. Do not make changes and rearrange circuits without prior approval.
3. If more than 3 current carrying conductors are installed in one conduit they shall be derated in accordance with the National Electric Code. Do not install more than three 30 Amp single phase or four 20 Amp single phase circuits in the same conduit.

K. Splices and Connections:

1. Makes splices electrically and mechanically secure with pressure-type connectors.

   a. For wires size #8AWG and smaller, provide solderless, screw-on connectors, "Scotch-Lock" or equal, 600V rating, of size and type to manufacturer's recommendation, with temperature ratings equal to the conductor insulation.
   b. Make splices and terminations to conductors #6AWG and larger with corrosion-resistant, high conductivity, pressure indent, hex screw or bolt clamp connectors, with or without tongues, designed specifically for intended service. Connectors for cables 250 kcmil and larger shall have two clamping elements or compression indents. Terminals for bus connections shall have two bolt holes. Splitbolt connectors, Burndy, Ilsco, or Greaves, shall be acceptable for all splices of conductors #6AWG and larger.

2. Insulate splices with a minimum of two layers of all weather, heavy duty, abrasion resistant, 8.5 mil thick, 105 degree C. rated vinyl electrical tape where insulation is required. Tape splices 1 ½ times the thickness of the conductor insulation.
3. Provide high conductivity copper alloy bolt-on lugs with pressure plate and socket set screw or hex head screw to attach wire and cable to disconnect switches, transformers, and other electrical equipment as required.
4. Provide cable reducing adaptor plugs where required for terminating oversize cable to standard size equipment lugs. Conductor strands shall not be cut in order to fit equipment lugs.
5. Provide antioxidant joint compound for all conductor connections.

3.5 OUTLET BOXES:

A. Obtain exact locations of outlets and fixtures from Owner prior to roughing. Make reasonable changes, as defined by Owner in location of outlets and equipment prior to roughing, at no additional cost. Give particular attention to outlets installed in and around casework.

B. All outlet boxes in finished areas shall be concealed from view above hung ceilings or recessed (flush) in walls and floors. Outlet boxes may only be exposed to view or surface mount type in mechanical and electrical rooms, for feeding items overhead in rooms without ceilings, and for surface mount devices on existing walls.

C. Install outlet boxes at uniform heights and straight and true with reference to walls, floors, ceilings and casework.

D. Provide knockout plugs in boxes with unused openings.

E. Secure all outlet boxes to building structure with metal straps, rods, or bolts independently of entering conduits or cables.

F. Provide bar hanger outlets in hollow framed partitions with bar hanger secured to partition studs with self-threading screws, or drill through hangers with Caddy or equal clips.

G. Provide horizontal separation for outlet boxes mounted on opposite sides of common wall. Back to back or thru-wall boxes will not be permitted.

3.6 PULL BOXES AND JUNCTION BOXES:

A. Provide pull boxes and junction boxes where shown on the plans and where required to facilitate proper pulling of wires and cables. Install pull boxes no less than one every 100 ft. of straight horizontal conduit run, or three 90 degree bends, unless otherwise noted.

3.7 WIRING DEVICES:

A. Wherever possible install switches directly adjacent to the strike side of door. Check architectural drawings for door swing.

B. Device mounting heights indicated below are general. Refer to drawings for special cases. Mounting heights are to centerline of device whether shown on plans or indicated below.

Receptacles	1’-6” AFF	Switches	4’-0” AFF

C. Install receptacles vertically with grounding posts at top of device, except locate grounding post to left for horizontal mounting.

3.8 WIRING DEVICE PLATES:

A. Set plates so that all edges are in contact with mounting surface. Provide common device plate for multi-device locations.

B. Provide electric outlet and switch sealers for all receptacles, switches and technology outlets installed at exterior walls.

C. Align all wall plate screws with screw slots aligned in the vertical position.

3.9 MOTOR POWER AND CONTROL WIRING:

A. Contractor shall provide and be responsible for the complete power wiring of all motors and motorized equipment.

B. Furnish proper overload and short circuit protection for all new motors. Provide a combination thermal overload and disconnect for switch all equipment using fractional horsepower motors.

C. Check electrical connections and sizing of motor circuit protection and prevent damage to motor and equipment from incorrect direction of rotation.

D. Provide mounting for motor and equipment disconnect switches adjacent to motor and supported independent of motor.

E. Motor starters and disconnects, where grouped, shall be mounted on ¾” thick fire retardant plywood mounting boards painted with light gray fire resistant paint.

F. Provide interlock wiring where required for motors and controllers, whether shown on the drawings or not.

G. Connections to miscellaneous building equipment:

1. Wire to and connect to, all items of building equipment not specifically described in this Section but to which electrical power is required.
2. Coordinate as necessary with other trades and suppliers to verify types, numbers and locations of equipment.

3.10 GROUNDING SYSTEM:

A. Provide a complete grounding system which will thoroughly ground the non-current carrying metal parts of every piece of installed equipment, as described herein and as indicated on the drawings.

B. System shall be mechanically and electrically connected to provide an independent return path to the grounding sources.

C. Each grounding conductor shall have a minimum capacity of 25 percent of the rated capacity of the equipment it grounds, unless otherwise indicated.

D. The minimum size of grounding conductors shall be No. 12 AWG copper. Insulation color of grounding conductors shall be green.

E. Provide insulated throat grounding bushings at all feeder conduit connections to switchboards, panelboards, disconnect switches, wireways, and pull boxes. Connect grounding bushings within each enclosure, backbox, wireway, or pull box by #4 AWG bare copper bonding conductor connected to a grounding lug welded to the enclosure, backbox, wireway, or pull box.

F. Provide a separate green ground conductor for each feeder and branch circuit.

G. Grounding of Motors: Motors shall be grounded by connecting a green covered conductor from a grounding bushing in the starter to the motor frame. Conductor shall be installed in the conduit with the circuit conductors and terminated in the motor connection box, providing the terminal is mechanically connected to the frame. If this is not feasible, grounding conductor from the starter shall be extended through an insulated bushed opening in the connection box and connected to motor base.

H. Tests: Entire system shall be thoroughly tested on completion for ground continuity and capacity. Provide not more than 10 ohms resistance between main ground system and equipment frame system neutral and/or derived neutral point.

3.11 SPECIAL REQUIREMENTS:

A. Wiring shall be bundle tied where passing through pull boxes, wireways, and panelboards in neat and orderly manner with plastic cable ties. Cable ties shall be Ty-Raps as manufactured by Thomas & Betts, or equal.

B. Turn branch circuits and auxiliary system wiring out of wiring gutters at 90 degrees to circuit breakers and terminal lugs.

C. Provide two spare 1 1/2 inch conduits for flush panels. Conduits shall extend from top of each panel to one foot above hung ceilings, turn out from wall toward panel access side and terminate with nylon bushing.

D. Provide miscellaneous hardware and support accessories, including support rods, nuts, bolts, screws, and other such items, with galvanized or cadmium plated finish, or other approved rust inhibiting coatings.

E. Unload electrical equipment and materials delivered to site. Pay cost for rigging, hoisting, lowering and moving electrical equipment on site, in building or on roof. During construction provide additional protection against moisture, dust accumulation and physical damage of electrical equipment. Provide temporary heaters within units, as approved to evaporate excessive moisture and provide ventilation as required.

3.12 TESTING AND INSPECTION:

A. Provide personnel and equipment, make required tests, and secure required approvals from the Architect and governmental agencies having jurisdiction.

B. When material and/or workmanship is found to not comply with the specified requirements, within three days after receipt of notice of such non-compliance remove the non-complying items from the job site and replace them with items complying with the specified requirements, all at no additional cost to the Owner.

C. Perform all required adjustments and settings. Verify and correct deficiencies as necessary including voltages, tap settings, trip settings and phasing of equipment from distribution system to point of use.

D. Provide all necessary testing equipment.

E. Test wiring, buswork, and connections for continuity and ground by “megger” test. Minimum insulation resistance between conductors and ground shall be as follows:

1. For circuits of #14 or #12 AWG wire: 1,000,000 ohms.
2. Conductor current carrying capacities from 25 to 50 amperes, inclusive: 250,000 ohms.
3. Conductor current carrying capacities from 51 to 100 amperes, inclusive: 100,000 ohms.
4. Conductor current carrying capacities from 101 to 200 amperes, inclusive: 50,000 ohms.
5. Conductor current carrying capacities from 201 to 400 amperes, inclusive: 25,000 ohms.
6. Conductor current carrying capacities from 401 to 800 amperes, inclusive: 12,000 ohms.
7. Conductor current carrying capacities over 800 amperes: 5,000 ohms.

F. Main ground electrode system shall not exceed 10 ohms unless specified otherwise.
1. Verify ground resistance by ground continuity test between main ground system and equipment frame system neutral and/or derived neutral point.

2. Perform ground continuity test by passing minimum of ten Amps DC between ground reference system and ground point. Calculate resistance by voltage drop method.

G. In the Owner's Presence:

1. Test all parts of the electrical system and prove that all such items provided under this Section function electrically in the required manner.

H. Balance all panels as follows:

1. Turn on all lighting and equipment served by a panel and measure the current in each branch circuit phase and neutral conductor and in each phase and neutral bus-bar. Log all measurements taken and then correct imbalance by substituting branch circuits from phase to phase until optimum balance is achieved. Log all final current measurements and submit for the Engineer's review.

2. Also measure and log voltages between each phase bus-bar and between each phase bus-bar and neutral bus-bar and submit measurements for the Engineer's review.

3.13 PROJECT COMPLETION:

A. Upon completion of the work of this Section, thoroughly clean all exposed portions of the electrical installation, removing all traces of soil, labels, grease, oil and other foreign material, and using only the type cleaner recommended by the manufacturer of the item being cleaned.

B. Vacuum all exteriors and interiors of switchboards, panelboards, safety switches, and equipment racks to remove all dust, dirt, cable clippings, etc.

C. Equipment with damage to painted finish shall be repaired to satisfaction of the Owner.

D. On the first day the facility is in operation, for at least eight hours, at a time directed by the Owner, provide a qualified foreman and crew to perform such electrical work as may be required by the Owner.

E. Thoroughly indoctrinate the Owner's operation and maintenance personnel in the contents of the operations and maintenance manual required to be submitted under these Specifications.

3.14 EQUIPMENT SPECIFIED:

A. Contractor shall furnish equipment or systems in manufacturers specified or named herein or on the drawings. No other manufacturers shall be considered.

END OF SECTION 26 05 00