TOWN OF HAMDEN

CONNECTICUT

TOWN OF HAMDEN
INVITATION TO BID
BID #2814
HAMDEN HIGH SCHOOL LOCKER ROOM ROOF TOP HEATING/VENTILATION PROJECT

The Town of Hamden is publicly seeking competitive bids from qualified companies for the above-referenced work.

A pre-bid meeting will be held at **2:00 P.M. on July 19, 2016** at Hamden High School, 2040 Dixwell Avenue, Hamden, Connecticut.

Sealed proposals (1 original and 4 copies) will be received at the Finance Office to be held in the Purchasing lock box until **11:00 A.M.** on July **25, 2016** at which time they will be publicly opened and read aloud. Bids received after the time set will be considered informal and will be rejected.

It is the sole responsibility of the bidder to see that the bid is in the hands of the proper authority prior to the bid opening time.

Specifications for this Bid/RFP may be downloaded at www.biznet.ct.gov or a PDF version may be obtained by e-mailing a request to purchasing@hamden.com or may be obtained at the Purchasing Office, Hamden Government Center 2750 Dixwell Avenue, Hamden, CT between the hours of 8:30 A.M. and 4:30 P.M., Telephone (203) 287-7110.

The Town of Hamden reserves the right to accept or reject any or all options, bids, or proposals, to waive any technicality in a bid or part thereof submitted, and to accept the bid deemed to be in the best interest of the Town of Hamden.

A MANDATORY PRE-BID MEETING WILL BE HELD AT HAMDEN HIGH SCHOOL 2040 DIXWELL AVE. HAMDEN, CT AT 2:00 P.M. on July 19, 2016

Philip W. Goodwin
Purchasing Agent

SECTION 230400 - GENERAL CONDITIONS FOR MECHANICAL TRADES

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

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

B. This section applies to certain sections of Division 26, "Electrical", Division 28, "Commissioning", and this section applies to all sections of Division 23, "Mechanical" and Division 23, "Building Automation" of this project specification unless specified otherwise in the individual sections.

1.2 DESCRIPTION

A. The General Conditions and Supplementary General Conditions are a part of this Division and are to be considered a part of this Contract.

B. Where items of the General Conditions and Supplementary General Conditions are repeated in other Sections of the Specifications, it is merely intended to qualify or to call particular attention to them. It is not intended that any other parts of the General Conditions and Supplementary General Conditions shall be assumed to be omitted if not repeated therein. This Section applies equally and specifically to all Contractors supplying labor and/or equipment and/or materials as required under each Section of this Division. Where conflicts exist between the drawings and the specifications or between this section of the specifications and other sections, the more stringent or higher cost option shall apply.

1.3 INTENT

A. It is the intent of the Specifications and Drawings to call for finished work, tested and ready for operation.

B. Any apparatus, appliance, material or work not shown on drawings but mentioned in the specifications, or vice versa, or any incidental accessories necessary to make the work complete and perfect in all respects and ready for operation as determined by good trade practice even if not particularly specified, shall be furnished, delivered and installed under their respective Divisions without any additional expense to the Owner.

C. Minor details not usually shown or specified but necessary for proper installation and operation shall be included in the work as though they were hereinafter shown or specified.

D. Work under each Section shall include giving written notice to the Owner and Engineer of any materials or apparatus believed inadequate or unsuitable; in violation of laws, ordinances, rules or regulations of authorities having jurisdiction; and any necessary items of work omitted. In the absence of such written notice, it is mutually agreed that work under each Section includes the system without extra compensation.

1.4 DEFINITIONS

A. Approve: The term "approved," where used in conjunction with the Engineer's action on the Contractor's submittals, applications, and requests, is limited to the Engineer's duties and responsibilities as stated in General and Supplementary Conditions.

B. "Approved equal" mean any product which in the opinion of the Engineer is equal in quality, arrangement, appearance, and performance to the product specified.

C. Directed: Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean "directed by the Engineer," "requested by the Engineer," and similar phrases.

D. "Finished" refers to all rooms and areas to be specified to receive architectural treatment as indicated on the drawings. All rooms and areas not covered, including underground tunnels and areas above ceilings shall be considered not finished, unless otherwise noted.

E. "Furnish" or "supply" shall mean purchase, deliver to, and off-load at the job site, ready to be installed including where appropriate all necessary interim storage and protection.

F. Indicated: The term "indicated" refers to graphic representations, notes, or schedules on the Drawings, other paragraphs or schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled" and "specified" are used, it is to help the reader locate the reference; no limitation on location is intended.

G. "Install" shall mean set in place complete with all mounting facilities and connections as necessary ready for normal use or service.

H. "Product" shall mean any item of equipment, material, fixture, apparatus, appliance or accessory installed under this Division.

I. "Provide" shall mean furnish (or supply) and install as necessary.

J. Regulation: The term "Regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

K. Remove: The term "remove" means "to disconnect from its present position, remove from the premises and to dispose of in a legal manner."

L. Special Warranties: The term "Special Warranties" are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

M. Standard Product Warranties: The terms "Standard Product Warranties" are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.

N. "Subcontractor" means specifically the subcontractor working under this Division. Other Contractors are specifically designated "Plumbing Subcontractor", "General Contractor" and so on. Note: Take care to ascertain limits of responsibility for

connecting equipment which requires connections by two or more trades.

O. Substitutions: Requests for changes in products, materials, equipment, and methods of construction proposed by the Contractor are considered requests for "substitutions."

P. "Wiring" shall mean cable assembly, raceway, conductors, fittings and any other necessary accessories to make a complete wiring system.

1.5 DRAWINGS

A. Work under each Section shall closely follow Drawings in layout of work; check Drawings of other Divisions to verify spaces in which work will be installed. Maintain maximum headroom; where space conditions appear inadequate, Owner and Engineer shall be notified before proceeding with installations.

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

C. Where variances occur between the Drawings and Specifications or within either of the Documents, the item or arrangement of better quality shall be included in the Contract price. The Owner and Engineer shall decide on the item and the manner in which the work shall be installed.

1.6 SURVEYS AND MEASUREMENTS

A. The Contractor shall base all measurements, both horizontal and vertical, from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at the site and check the correctness of same as related to the work.

B. Should the Contractor discover any discrepancies between actual measurements and those indicated which prevent following good practice or which interfere with the intent of the Drawings and Specifications, the Engineer will be notified and work will not proceed until instructions from the Engineer are received.

1.7 CODES AND STANDARDS

A. Reference Standard Compliance

1. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), and Underwriters Laboratories Inc. (UL), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.

2. Independent Testing Organization Certificate: In lieu of the label or listing indicated above, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Engineer. The certificate shall state that the item has been tested in

accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

B. The Following Codes and Standards listed below apply to all mechanical work. Wherever Codes and/or Standards are mentioned in these Specifications, the latest applicable edition or revision shall be followed:

Connecticut State Building Code - Connecticut Supplement

The International Building Code

The International Mechanical Code

The International Plumbing Code

The International Plumbing Code

The International Energy Conservation Code

NFPA 101 Life Safety

ASHRAE 90.1 and International Energy Conservation Code

C. The following Standards shall be used where referenced by the following abbreviations:

AABC	Associated Air Balance Council
ACGIH	American Conference of Governmental Industrial Hygienists
ADC	Air Diffusion Council
AGA	American Gas Association
AIA	American Institute of Architects
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
API	American Petroleum Institute
ARI	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASSE	American Society of Sanitary Engineers

ASTM	American Society of Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
CGA	Compressed Gas Association
CSA	Canadian Standards Association
CISPI	Cast Iron Soil Pipe Institute
EJMA	Expansion Joint Manufacturing Association
EPA	Environmental Protection Agency
FM	Factory Mutual
FSSC	Federal Specification
HIS	Hydraulic Institute Standards
IEEE	Institute of Electrical and Electronics Engineers
IRI	Industrial Risk Insurers
ISO	Insurance Services Office
MCAA	Mechanical Contractors Association of America
NBS	National Bureau of Standards
NEBB	National Environmental Balancing Bureau
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NOFI	National Oil Fuel Institute
NSC	National Safety Council
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Administration
PDI	Plumbing and Drainage Institute
SBI	Steel Boiler Industry (Division of Hydronics Institute)
SMACNA	Sheet Metal and Air Conditioning Contractors National Association

STI Steel Tank Institute

UL Underwriters' Laboratories

D. All materials furnished and all work installed shall comply with the rules and recommendations of the NFPA, the requirements of the local utility companies, the recommendations of the fire insurance rating organization having jurisdiction and the requirements of all Governmental departments having jurisdiction.

E. The Contractor shall include in the work, without extra cost to the Owner, any labor, materials, services, apparatus and Drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether shown on Drawings and/or specified or not.

1.8 PERMITS AND FEES

A. The Contractor shall give all necessary notices, obtain all permits; and pay all Government and State sales taxes and fees where applicable, and other costs, including utility connections or extensions in connection with the work, file all necessary Drawings, prepare all documents and obtain all necessary approvals of all Governmental and State departments having jurisdiction, obtain all required certificates of inspection for his work, and deliver a copy to the Owner and Engineer before request for acceptance and final payment for the work.

1.9 EQUIPMENT SUBSTITUTIONS

A. In these Specifications and on the accompanying Drawings, one or more makes of materials, apparatus or appliances may have been specified for use in this installation. This has been done for convenience in fixing the standard of workmanship, finish and design required for installation. The details of workmanship, finish and design, and the guaranteed performance of any material, apparatus or appliance which the Contractor desires to deviate from those mentioned herein shall also conform to these standards.

B. Where no specific make of material, apparatus or appliance is mentioned any first-class product made by a reputable manufacturer may be submitted for the Engineers review. Specified item or one of the named equivalents. Where one name only is used and is followed by the words "or approved equal", the Contractor must use the item named or he may apply for a substitution. Where one name only is used, the Contractor must use that item named.

D. Equipment, material or devices submitted for review as an "equivalent" shall meet the following requirements:

1. The equivalent shall have the same construction features such as, but not limited to:

a. Material thickness, gauge, weight, density, etc. b.

welded, riveted, bolted, etc., construction.

c. Finish, undercoating, corrosion protection.

2. The equivalent shall perform with the same or better operating efficiency.

3. The equivalent shall be locally represented by the manufacturer for service, parts and technical information.

4. The equivalent shall bear the same labels of performance certification as is applicable to the specified item, such as AMCA or ARI labels.

E. Where the Contractor proposes to deviate from the equipment or materials as hereinafter specified, he shall do so by making a request in writing. The Contractor shall state in his request the amount of credit or extra cost involved. A copy of said request shall be included in the Mechanical Base Bid with manufacturer's equipment cuts. The Base Bid shall be based on using the materials and equipment as specified with no exceptions.

F. Where the Contractor proposes to use an item of equipment other than specified or detailed on the Drawings which requires any redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical, electrical or architectural layout, all such redesign and all new drawings and detailing required therefore shall be prepared by the Designers of Record at the expense of the Contractor and at no additional cost to the Owner.

G. Where such accepted substitution requires a different quantity and arrangement of piping, ductwork, valves, pumps, insulation, wiring, conduit and equipment from that specified or indicated on the Drawings, the Contractor shall, with the acceptance by the Engineer, furnish and install any such additional equipment required by the system at no additional cost to the Owner, including any costs added to other trades due to the substitution.

H. Equipment, material or devices submitted for review as a "substitution" shall meet the following requirements:

1. Substitution Request Submittal: Requests for substitution will be considered if received in writing 14 days before the bid date. Requests rejected at the discretion of the Engineer.

a. Submit three (3) copies of each request for substitution for consideration.

b. Identify the product, or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:

1) Product Data, including Drawings and descriptions of products, fabrication and installation procedures.

2) Samples, where applicable or requested.

3) A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements such as size, weight, durability, performance and visual effect.

4) Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate Contractors that will become necessary to accommodate the proposed substitution.

5) A statement indicating the substitution's effect on the Contractor's Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.

6) Cost information, including a proposal of the net change, if any in the Contract Sum.

7) Certification by the Contractor that the substitution proposed is equal-to or better in every significant respect to that required by the Contract Documents, and that it will perform adequately in the application indicated. Include the Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.

2. Engineer's Action: Within one week of receipt of the request for substitution, the Engineer will notify the Contractor of acceptance or rejection of the proposed substitution. If a decision on use of a proposed substitute cannot be made or obtained within the time allocated, use the product specified by name. Acceptance of a product substitution will be in the form of an Addendum and considered by the Engineer when one or more of the following conditions are satisfied, as determined by the Engineer; otherwise requests will be returned without action except to record noncompliance with these requirements.

a. The specified product or method of construction cannot be provided within the Contract Time. The request will not be considered if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.

b. A substantial advantage is offered to the Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities the Owner may be required to bear. Additional responsibilities for the Owner may include additional compensation to the Engineer for redesign and evaluation services, increased cost of other construction by the Owner or separate Contractors, and similar considerations.

1.10 SHOP DRAWINGS

A. Submit neatly prepared information, drawn to accurate scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not considered Shop Drawings.

B. The Contractor shall submit for review detailed shop drawings of all equipment and material specified in each section and coordinated ductwork layouts. No material or equipment may be delivered to the job site or installed until the Contractor has received shop drawings for the particular material or equipment which have been properly reviewed. Shop drawings shall be submitted within 60 days after award of Contract before any material or equipment is purchased. The Contractor shall submit for review copies of all shop drawings to be incorporated in the Mechanical Contract. Refer to Division 1 for the quantity of copies required for submission. Where quantities are not specified, provide seven (7) copies for review.

C. Provide shop drawings for all devices specified under equipment specifications for all systems. Shop drawings shall include manufacturers' names, catalog numbers, cuts, diagrams, dimensions, identification of products and materials included compliance with specified standards, notation of coordination requirements, notation of dimensions established by field measurement and other such descriptive data as may be required to identify and accept the equipment. A complete list in each category (example: all fixtures), of all shop drawings, catalog cuts, material lists, etc., shall be submitted to the Engineer at one time. No consideration will be given to a partial shop drawing submittal.

D. When a submittal could involve more than one trade, e.g., valves, piping, etc., the submitted shall be separated by traded involved, i.e. HVAC, plumbing, fire protection, etc.

E. Where multiple quantities or types of equipment are being submitted, provide a cover sheet (with a list of contents) on the submittal identifying the equipment or material being submitted.

F. The Contractor shall furnish all necessary templates, patterns, etc., for installation work and for the purpose of making adjoining work conform; furnish setting plans and shop details to other trades as required.

G. "No Exception Taken" rendered on shop drawings shall not be considered as a guarantee of measurements or building conditions. Where drawings are reviewed, review does not mean that drawings have been checked in detail; said approval 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. Verify available space prior to submitting shop drawings. Review of shop drawings shall not apply to quantity of material.

H. After shop drawings have been reviewed, with no exceptions taken, no further changes will be allowed without the written consent of the Engineer.

I. Shop drawing submittal sheets which may show items that are not being furnished shall have those items crossed off to clearly indicate which items will be furnished.

J. Bidders shall not rely on any verbal clarification of the Drawings and/or Specifications. Any questions shall be referred to the Engineer in writing at least five (5) working days prior to bidding to allow for issuance of an Addendum.

K. Do not use Shop Drawings without an appropriate final stamp indicating action taken in connection with construction.

L. Prepare sheetmetal and sprinkler shop drawings drawn in the latest AutoCAD version to a minimum scale of 1/4" = 1'- 0". Final approved drawings shall be turned over to the Owner on CD Rom.

1.11 COORDINATION WITH OTHER DIVISIONS

A. All work shall be carried out in conjunction with other trades and full cooperation shall be given in order that all work may proceed with a minimum of delay and interference. Particular emphasis is placed on timely installation of major apparatus and furnishing other Contractors, especially the Contractor or Construction Manager, with information as to openings, chases, sleeves, bases, inserts equipment locations, panels, etc., required by other trades.

B. The Contractors are required to examine all of the Project Drawings and mutually arrange work so as to avoid interference with the work of other trades. In general, ductwork, HVAC piping, sprinkler piping and drainage lines take precedence over water, gas and electrical conduits. The Engineer shall make final decisions regarding the arrangement of work which cannot be agreed upon by the Contractors.

C. Where the work of the Contractor will be installed in close proximity to or will interfere with work of other trades, the Contractors will cooperate in working out space conditions to make a satisfactory adjustment.

D. If the work under a Section is installed before coordinating with other Divisions or Sections or so as to cause interference with work of other Sections, the necessary changes to correct the condition shall be made by the Contractor causing the interference without extra charge to the Owner.

1.12 WORKMANSHIP

A. Service Support: The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

B. Modification of References: In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears.

C. The Contractor shall furnish the services of an experienced superintendent who shall be constantly in charge of the installation of the work together with all skilled workmen, fitters, metal workers, welders, helpers and laborers required to unload, transfer, erect, connect, adjust, start, operate and test each system.

D. Unless otherwise specifically indicated on the Drawings or Specifications, all equipment and materials shall be installed with the acceptance of the Engineer

And in accordance with the recommendations of the manufacturer. This includes the performance of such tests as the manufacturer recommends.

E. All labor for installation of mechanical systems shall be performed by experienced, skilled tradesmen under the supervision of a licensed journeyman foreman. All work shall be of a quality consistent with good trade practice and shall be installed in a neat, workmanlike manner. The Engineer reserves the right to reject any work which, in his opinion, has been installed in a substandard, dangerous or unserviceable manner. The Contractor shall replace said work in a satisfactory manner at no extra cost to the Owner.

1.13 SHUTDOWNS

A. When installation of a new system requires the temporary shutdown of an existing operating system, the connection of the new system shall be performed at such time as designated by the Owner. All shutdowns of the Central Utility Plant shall occur during off hour times as designated by the owner. Shutdowns of Central Utility Plant shall not occur during such times that Hamden High School will be impacted during occupied hours.

B. The Engineer and the Owner shall be notified in writing of the estimated duration of the shutdown period at least ten (10) days in advance of the date the work is to be performed. Final approval of exact time for shutdown work shall be by owner. No shutdown work shall occur without approval of owner.

C. Work shall be arranged for continuous performance whenever possible. The Contractor shall provide all necessary labor, including overtime if required, to assure that existing operating services will be shut down only during the time actually required to make necessary connections.

1.14 PROTECTION OF MATERIALS AND EQUIPMENT

A. Work under each Section shall include protecting the work and material of all other Sections from damage by work or workmen and shall include making well all damage thus caused.

B. The Contractor shall be responsible for work and equipment until the facility has been accepted by the Owner. Protect work against theft, 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 foreign material.

C. Work under each Section includes receiving, unloading, uncrating, storing, protecting, setting in place and completely connecting equipment supplied under each Section. Work under each Section shall also include exercising special care in handling and protecting equipment and fixtures, and shall include the cost of replacing any of the equipment and fixtures which are missing or damaged.

D. Equipment and material stored on the job site shall be protected from the weather,

vehicles, dirt and/or damage by workmen or machinery. Insure that all electrical or absorbent equipment or material is protected from moisture during storage.

1.15 ADJUSTING AND TESTING

A. After all the equipment and accessories to be furnished are in place, they shall be put in final adjustment and subjected to such operating tests so as to assure the Engineer that they are in proper adjustment and in satisfactory, permanent operating condition.

B. Where requested by the Engineer, a factory-trained service representative shall inspect the installation and assist in the initial startup and adjustment to the equipment. The period of these services shall be for such time as necessary to secure proper installation and adjustments. After the equipment is placed in permanent operation, the service representative shall supervise the initial operation of the equipment and instruct personnel responsible for operation and maintenance of the equipment. The service representative shall notify the Contractor in writing that the equipment was installed according to manufacturer's recommendations and is operating as intended by the manufacturer.

1.16 CLEANING

A. The Contractor shall thoroughly clean and flush all piping, ducts and equipment of all foreign substances, oils, burrs, solder, flux, etc., inside and out before being placed in operation.

B. If any part of a system should be stopped or damaged by any foreign matter after being placed in operation, the system shall be disconnected, cleaned and reconnected wherever necessary to locate and/or 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 ducts and pipes shall be capped in an acceptable manner to insure adequate protection against the entrance of foreign matter.

D. Upon completion of all work under the Contract, the Contractor shall remove from the premises all rubbish, debris and excess materials left over from his work. Any oil or grease stains on floor areas caused by the Contractor shall be removed and floor areas left clean.

E. Complete the following cleaning operations before requesting inspection for Certification of Substantial Completion.

1. Remove labels that are not permanent labels.

2. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compound and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.

3. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition. Leave concrete floors broom clean. Vacuum carpeted surfaces.

4. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.

F. Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove and dispose of ALL waste materials, packaging material, skids etc. from the site and dispose of in a lawful manner in accordance with municipal, state and federal regulations.

G. Where extra materials of value remaining after completion of associated Work have become the Owner's property, arrange for disposition of these materials as directed.

1.17 OPERATING AND MAINTENANCE

A. Upon completion of all work and tests, the Contractor shall furnish the necessary skilled labor and helpers for operating his system and equipment for a period specified under each applicable Section of this Division. During this period, he shall fully instruct the Owner or the Owner's representative in the operation, adjustment and maintenance of all equipment furnished. The Contractor shall give notice to the Owner and the Engineer in advance of this period. Exact time at which this shall occur shall be approved by owner.

B. The Contractor shall include the maintenance schedule for the principal items of equipment furnished under this Division.

C. the Contractor shall physically demonstrate procedures for all routine maintenance of all equipment furnished under each respective Section to assure accessibility to all devices.

D. An authorized manufacturer's representative shall attest in writing that the equipment has been properly installed prior to startup of any major equipment. The following equipment will require this inspection: pumps; air conditioning equipment, controls, air handling equipment, compressors, boilers etc. These letters shall be bound into the operating and maintenance books.

E. Refer to individual trade Sections for any other particular requirements related to operating instructions.

F. Demonstration shall be recorded on DVD with two (2) DVD's turned over to the Owner.

1.18 OPERATING AND MAINTENANCE MANUALS

A. Prepare operating and maintenance manuals in accordance with the requirements of Division 1 and as follows. The Contractor shall prepare three (3) hard copies of a complete maintenance and operating instructions manual, bound in booklet form and two (2) copies in on a searchable CD Rom. Organize operating and maintenance data into suitable sets of manageable size. Bind hard copies properly indexed data in individual heavy-duty 3-ring vinyl-covered binders, with pocket folders for folded sheet information and designation partitions with identification

tabs. Mark appropriate identification on front and spine of each binder.

B. Manual shall include the following:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

4. Servicing and operating instructions including lubrication charts and schedules.

5. Emergency and safety instructions.

6. Spare parts list.

7. Copies of warranties.

8. Wiring diagrams.

9. Recommended "turn around" cycles.

10. Inspection procedures.

11. Approved Shop Drawings and Product Data.

12. Equipment Start-up Reports.

13. Temperature control diagrams and written sequences of operations.

14. Balance reports.

C. Include in the manual, a tabulated equipment schedule for all equipment. Schedule shall include pertinent data such as: make, model number, serial number, voltage, normal operating current, belt size, filter quantities and sizes, bearing number, etc. Schedule shall include maintenance to be done and frequency.

D. Maintenance and instruction manuals shall be submitted to the Owner at the same time as the notice is given prior to the instruction period.

1.19 ACCEPTANCES

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

B. Within 30 days after the awarding of a Contract, the Mechanical Contractor shall submit to the Engineer, for review, a list of manufacturers of equipment proposed for the work under the Mechanical Sections. The intent to use the exact manufacturers and models specified does not relieve the Contractor of the responsibility of submitting such a list.

C. If extensive or unacceptable delivery time is expected on a particular item of equipment specified, the Contractor shall notify the Owner and Engineer, in writing, within 30 days of award of the Contract. In such instances, equipment substitutions may be made pending acceptance by the Engineer or the Owner's representative.

D. Where any specific material, process or method of construction or manufactured article is specified by reference to the catalog number of a manufacturer, the Specifications are to be used as a guide and are not intended to take precedence over the basic duty and performance specified or noted on the Drawings. In all cases, the Mechanical Contractor shall verify the duty specified with the specific characteristics of the equipment offered for review. Equipment characteristics are to be used as mandatory requirements where the Contractor proposes to use an acceptable equivalent.

E. If material or equipment is installed before it is reviewed and/or approved, the Contractor shall be liable for its removal and replacement at no extra charge to the Owner if, in the opinion of the Engineer, the material or equipment does not meet the intent of, or standard of quality implied by, the Drawings and Specifications.

F. Failure on the part of the Engineer to reject shop drawings or to reject work in progress shall not be interpreted as acceptance of work not in conformance with the Drawings and/or Specifications. Work not in conformance with the Drawings and/or Specifications shall be corrected whenever it is discovered.

1.20 RECORD DRAWINGS

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

B. Prepare record drawings in accordance with the requirements of Division 1 and as follows. Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately. Give particular attention to concealed elements that would be difficult to measure and record at a later date. Items to be indicated include but are not limited to:

1. Dimensional change
2. Revision to drawing detail
3. Location and depth of underground utility
4. Revision to pipe routing
5. Revision to electrical circuitry

6. Actual equipment location

7. Duct size and routing

8. Location of concealed internal utility

9. Changes made by Change Order

10. Details not on original Contract Drawing

11. Information on concealed elements which would be difficult to identify or measure later

C. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of the Work.

D. Mark new information that is important to the Owner, but was not shown on Contract Drawings or Shop Drawings.

E. Note related Change Order numbers where applicable.

F. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.

G. Final record documents shall consist of (1) set of marked-up Record Prints, one (1) set of Record CAD Drawing files on CD Rom, one (1) set of record CAD drawing plots, and three (3) copies printed from record plots. Plot and print each drawing, whether or not changes and additional information were recorded.

1.21 WARRANTIES AND BONDS

A. The following general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturer's standard warranties on products and special warranties are to be included:

1. General close-out requirements included in Division 1.

2. Specific requirements for warranties for the Work and products and installation that are specified to be warranted, are included in the individual Sections of Divisions-2 through -17.

3. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.

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

C. Separate Prime Contracts: Each prime Contractor is responsible for warranties related to

its own Contract.

1.22 WARRANTY REQUIREMENTS

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

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

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

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

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

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

G. Submit written warranties to the Engineer/Commissioning agent prior to the date certified for acceptance of operational systems by Commissioning Agent. If the commissioning agent acceptance of systems occurs on a date different from the warranty start date listed on the warranty certificate, submit updated written warranties which reflect this date.

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

1. Refer to individual Sections of Divisions-2 through -17 for specific content requirements, and particular requirements for submittal of special warranties.

I. Form of Submittal: At Final Completion compile two copies of each required warranty and bond properly executed by the Contractor, or by the Contractor, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.

J. Bind warranties and bonds in heavy-duty, commercial quality, durable 3-ring vinyl

covered loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2" by 11" paper.

1. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address and telephone number of the installer.

2. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS," the Project title or name, and the name of the Contractor.

3. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

1.23 GUARANTEES

A. The Contractor shall guarantee all material and workmanship under these Specifications and the Contract for a period of one (1) year from the date of final acceptance of overall systems by the commissioning agent. During this guarantee period, all defects developing through faulty equipment, materials or workmanship shall be corrected or replaced immediately by this Contractor without expense to the Owner. Such repairs or replacements shall be made to the Engineer's satisfaction.

B. Contractor shall provide name, address, and phone number of all contractors and subcontractors and associated equipment they provided.

1.24 PROJECT CLOSE-OUT

A. All warranties shall be from date of final acceptance of full system by the commissioning agent. Each piece of equipment shall of the same date.

B. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents in accordance with Division 1.

C. Deliver tools, spare parts, extra stock, and similar items.

D. Complete start-up testing of systems, and instruction of the Owner's operating and maintenance personnel. Discontinue or change over and remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.

E. Complete final clean up requirements, including touch-up painting. Touch-up and otherwise repair and restore marred exposed finishes.

F. Field Observation Procedures: On receipt of a request for an Engineers Field Observation, the Engineer will advise the Contractor of unfulfilled requirements. The Engineer will advise the Contractor of construction that must be completed or corrected before the certificate will be issued.

1. The Engineer will repeat the Field Observation when requested and assured that the Work has been substantially completed.

2. Results of the completed list of unfulfilled items will form the basis of requirements for final acceptance.

END OF SECTION

SECTION 23 0500

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
1. Mechanical demolition.
2. Equipment installation requirements common to equipment sections.
3. Painting and finishing.
4. Supports and anchorages.
5. Plumbing Sleeves, Inserts, and Core Drilling.
6. Guarantees and Maintenance service.
7. Application, securing, and payment for all permits, certificates, taxes, fees, inspections, tests and approvals required in connection with all plumbing and mechanical work under this Section.
8. Access Panels.
9. Maintenance service for one year after project opening.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. "Furnish and Install" or "Provide" means to supply, erect, install and connect, to complete for readiness for regular operation.

G. "Plumbing Contractor" The Plumbing Contractor and any of his subcontractors, vendors, suppliers or fabricators.

H. "Piping" includes in addition to pipe, all fittings, valve hangers, and other accessories relative to such piping.

I. "Concealed means hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction, or in crawl spaces.

J. "Exposed means not installed underground or "Concealed" as defined above.

1.4 SHOP DRAWINGS AND EQUIPMENT SUBMITTALS:

1.5 LAWS AND ORDINANCES:

A. All plumbing work shall be installed and tested in accordance with the Building Code of the State of Connecticut as revised to date and with all other State Codes governing this work that may apply.

B. Gas fitting shall be done in compliance with NFPA, State Gas Code Requirements and those of the company supplying the gas.

C. The Mechanical Contractor shall file all required notices and plans with the proper authorities and shall secure and pay for all necessary permits inspections and costs incidental to his work beyond the regular Building Permit, no work shall commence prior to this.

D. The selection of all plumbing materials and equipment shall conform to the latest edition of the prevailing State Codes and Local Ordinances.

E. Where the requirements of this specification are more stringent than the prevailing State Codes and Local Ordinances, the requirements of this specification shall govern.

F. All work shall conform to all applicable state and local codes and the latest editions of applicable Factory Mutual Data Sheets.

1.6 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If

minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.8 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

1.9 EXCAVATION AND BACKFILL:

A. Pipe bedding shall be in accordance with provisions of sections on excavation and backfill. Work under this section shall commence only after proper bedding material has been provided, graded and properly compacted. Excavation shall be kept open until system has been inspected, tested and approved.

B. Plumbing Contractor shall observe all excavation, backfilling and compaction of all underground piping associated with work under this section.

1.10 GUARANTEES:

A. Furnish to the Owner at the completion of this work, a written guarantee (in triplicate) stating that all equipment, materials, and work performed are in full accordance with the drawings and specifications. The guarantee shall also state that this work and all subsequent Change Orders, are fully guaranteed for 1 year from the date of final acceptance, and any equipment, materials, or workmanship which may prove defective within that time will be replaced at no cost to the Owner.

1. Mechanical contractor are each responsible to provide full maintenance service on respective equipment for a period of one year after completion.

a. Maintenance shall include but not be limited to: changing of filters, cleaning of strainers, and lubrication of equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

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

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division for piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

PART 3 - EXECUTION

A. ACCESS AND ACCESS PANELS:

1. All work by Plumbing Contractor shall be performed so as to provide proper access to equipment and materials, which may need inspection, replacement, repair, or service. If proper access cannot be provided confer with Architect as to best method of approach effect of reduced access which may result.
2. Furnish access panels where any traps, valves, specialties, and/or other items specified herein which require access are concealed in floors, walls, and furred spaces or above ceilings.
3. Ceilings consisting of lay in or removable splined tiles do not require access panels. Valves above ceiling shall have locations marked with red thumb tacks on finished ceiling.
4. Access panel finish shall be coordinated with Architect.

3.2 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

E. Contractor shall provide flanges in accordance with ANSI standards for construction and working pressure. Flange material shall be ferrous for ferrous piping systems and bronze for non-ferrous systems.

F. Plumbing Contractor shall furnish and install approved Dielectric couplings wherever domestic water piping system comes in contact with ferrous pipe, fittings, valves, equipment etc., which makes up the domestic water system.

3.3 PAINTING

A. Painting of mechanical systems, equipment, and components AS specified below.

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

C. Paint all exposed piping blue for CHW and red for HW oil based paint.

D. Concrete pads and floor grey industrial oil paint.

E. Walls and ceiling- 2 coats white paint with primer

3.4 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 5 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.6 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.7 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 23 0500

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

   a. Constant-volume air systems.
   b. Dual-duct systems.
   c. Variable-air-volume systems.
   d. Multizone systems.
   e. Induction-unit systems.

2. Balancing Hydronic Piping Systems:

   a. Constant-flow hydronic systems.
   b. Variable-flow hydronic systems.
   c. Primary-secondary hydronic systems.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 ACTION SUBMITTALS

A. LEED Submittals:

1. Air-Balance Report for Prerequisite IEQ 1: Documentation of work performed for ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

2. TAB Report for Prerequisite EA 2: Documentation of work performed for ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 15 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 15 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. Certified TAB reports.

E. Sample report forms.

F. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.6 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by NEBB or TABB.
2. TAB Technician: Employee of the TAB contractor and who is certified by NEBB or TABB as a TAB technician.

B. TAB Conference: Meet with Owner on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Coordination and cooperation of trades and subcontractors.
d. Coordination of documentation and communication flow.

C. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard TAB contractor's forms approved by Engineer.

E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

F. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

G. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.7 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.8 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

A. Subject to compliance with requirements, available TAB contractors that may be engaged include, but are not limited to, the following:

1. Environmental Testing and Balancing

2. Wings Testing and Balancing

3. James Brennan Co.

4. Air Balance Service

3.2 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, flow-control devices, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the existing as-built drawings including HVAC system descriptions and layouts.

D. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

E. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

F. Examine operating safety interlocks and controls on HVAC equipment.

G. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:
   1. Automatic temperature-control systems are operational.
   2. Equipment and duct access doors are securely closed.
   3. Balance, smoke, and fire dampers are open.
   4. Windows and doors can be closed so indicated conditions for system operations can be met.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

   1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
3. Install and join new insulation that matches removed materials.

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

J. Check for proper sealing of air-handling-unit components.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
b. Measure static pressure directly at the fan outlet or through the flexible connection.
c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
6. Obtain approval from Owner for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
3. Measure total system airflow. Adjust to within indicated airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.

6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

    a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record final fan-performance data.

C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Balance variable-air-volume systems the same as described for constant-volume air systems.
2. Set terminal units and supply fan at full-airflow condition.
3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
4. Readjust fan airflow for final maximum readings.
5. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.

8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

    a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
3. Set terminal units at full-airflow condition.
4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Adjust terminal units for minimum airflow.
6. Measure static pressure at the sensor.
7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.8 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.9 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the condition of filters.
4. Check the condition of coils.
5. Check the operation of the drain pan and condensate-drain trap.
6. Check bearings and other lubricated parts for proper lubrication.
7. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.

2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
4. Balance each air outlet.

3.10 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.

3.11 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.12 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

    a. Unit identification.

b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Unit arrangement and class.
g. Discharge arrangement.
h. Sheave make, size in inches, and bore.
i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
j. Number, make, and size of belts.
k. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Preheat-coil static-pressure differential in inches wg.
g. Cooling-coil static-pressure differential in inches wg.
h. Heating-coil static-pressure differential in inches wg.
i. Outdoor airflow in cfm.
j. Return airflow in cfm.
k. Outdoor-air damper position.
l. Return-air damper position.
m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft..
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

   a. Air flow rate in cfm.
   b. Average face velocity in fpm.
   c. Air pressure drop in inches wg.
   d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
   e. Return-air, wet- and dry-bulb temperatures in deg F.
   f. Entering-air, wet- and dry-bulb temperatures in deg F.
   g. Leaving-air, wet- and dry-bulb temperatures in deg F.
   h. Water flow rate in gpm.
   i. Water pressure differential in feet of head or psig.
   j. Entering-water temperature in deg F.
   k. Leaving-water temperature in deg F.
   l. Refrigerant expansion valve and refrigerant types.
   m. Refrigerant suction pressure in psig.
   n. Refrigerant suction temperature in deg F.
   o. Inlet steam pressure in psig.

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

   a. System identification.
   b. Location.
   c. Make and type.
   d. Model number and size.
   e. Manufacturer's serial number.
   f. Arrangement and class.
   g. Sheave make, size in inches, and bore.
   h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:

   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.
   e. Sheave make, size in inches, and bore.
   f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
   g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

   a. Total airflow rate in cfm.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Suction static pressure in inches wg.

H. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated air flow rate in cfm.
h. Indicated velocity in fpm.
i. Actual air flow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

I. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft..

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm.
b. Air velocity in fpm.
c. Preliminary air flow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final air flow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

J. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.13 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:

   a. Measure airflow of at least 10 percent of air outlets.
   b. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
   c. Verify that balancing devices are marked with final balance position.
   d. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner or Engineer of Record.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Owner or Engineer of Record.
3. Owner shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.14 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 PROJECT SUMMARY

A. The scope of this project is to replace the existing control system serving the existing HVAC system in the 'A' wing of the Hamden High School. This includes the (4) air handling units, the VAV boxes with reheat coils and the exhaust fans.

1.3 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

B. The intent of this specification is to provide an open source Facility Management Control System (FMCS) based on the Tridium Niagara Network Area Controller (NAC) and the Honeywell Spyder Interoperable Digital Controller/Interoperable BACnet Controller (IDC/IBC). The Honeywell Spyder Interoperable Digital Controller Interoperable BACnet Controller (IDC/IBC) shall be fully programmable via the embedded Niagara WorkBench tool requiring only a web browser.

C. C.Furnish all labor, materials, equipment, and service necessary for a complete and operating Temperature Control System (TCS) and Facility Management system (FMCS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only.

D. D.All labor, material, equipment and software not specifically referred to herein or on the plans, that is required to meet the functional intent of this specification, shall be provided without additional cost to the Owner.

E. Related Sections include the following:
   1. Section 230993 "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

1.4 DEFINITIONS

A. DDC: Direct digital control.

B. I/O: Input/output.

C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.

D. MS/TP: Master slave/token passing.

E. PC: Personal computer.

F. PID: Proportional plus integral plus derivative.

G. RTD: Resistance temperature detector.

H. FMCS: Facility Management and Control System

I. TCS: Temperature Control System

J. NAC: Network Area Controller

K. IDC: Interoperable Digital Controller

L. IBC: Interoperable BACnet Controller

M. GUI: Graphical User Interface

N. WBI: Web Browser Interface

O. POT: Portable Operator's Terminal

P. PMI: Power Measurement Interface

Q. LAN: Local Area Network

R. WAN: Wide Area Network

S. OOT: Object Oriented Technology (Graphical Programming Language)

T. PICS: Protocol Implementation Conformance Statement

1.5 SYSTEM DESCRIPTION

A. The entire Temperature Control System (TCS) shall be comprised of a network of interoperable, stand-alone digital controllers communicating via LON communication protocols to a Network Area Controller (NAC). Temperature Control System products shall be manufactured by Honeywell. Equivalent LON products must be approved in writing by the consulting Engineer and be submitted for approval ten (10) days prior to the date of the bid submittal.

B. The Facility Management and Control System (FMCS) shall be comprised of Network Area Controller or Controllers (NAC) within each facility. The NAC shall connect to the owner's local or wide area network, depending on configuration. Access to the system, either locally in each building, or remotely from a central site or sites, shall be accomplished through standard Web browsers, via the Internet and/or local area network. Each NAC shall communicate to

LON controllers and other open protocol systems/devices provided under Division 15 or Division 16.

C. The Facility Management and Control System (FMCS) as provided in this Division shall be based on the Tridium Niagara System incorporating the Niagara Framework™. Equivalent products must be approved in writing by the consulting Engineer and be submitted for approval ten (10) days prior to the date of the bid submittal. Systems not developed on the Niagara Framework platform are unacceptable.

1.6 SEQUENCE OF OPERATION

A. Section 230993 "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

1.7 ACTION SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
3. Wiring Diagrams: Power, signal, and control wiring.
4. Details of control panel faces, including controls, instruments, and labeling.
5. Written description of sequence of operation.
6. Schedule of dampers including size, leakage, and flow characteristics.
7. Schedule of valves including flow characteristics.
8. DDC System Hardware:

   a. Wiring diagrams for control units with termination numbers.
   b. Schematic diagrams and floor plans for field sensors and control hardware.

c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.

9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
10. Controlled Systems:

a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
c. Written description of sequence of operation including schematic diagram.
d. Points list.

C. Samples for Initial Selection: For each color required, of each type of thermostat or sensor cover with factory-applied color finishes.

D. Samples for Verification: For each color required, of each type of thermostat or sensor cover.

1.8 INFORMATIONAL SUBMITTALS

A. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.

B. Field quality-control test reports.

1.9 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

B. Software and Firmware Operational Documentation: Include the following:

1. Software operating and upgrade manuals.
2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
3. Device address list.

4. Printout of software application and graphic screens.
5. Software license required by and installed for DDC workstations and control systems.

1.10 MAINTENANCE MATERIAL SUBMITTALS

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

1. Replacement Materials: One replacement diaphragm or relay mechanism for each unique valve motor and thermostat.
2. Maintenance Materials: One thermostat adjusting key(s).

1.11 QUALITY ASSURANCE

A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

B. System Software: Update to latest version of software at Project completion.

1.13 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

1.14 SOFTWARE LICENSE AGREEMENT

A. A.The Owner shall agree to the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software.

B. B.The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s). In addition, the Owner shall receive ownership of all job

specific configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and/or configured for use with the NAC, FMCS Server(s), and any related LAN / WAN / Intranet and Internet connected routers and devices. Any and all required IDs and passwords for access to any component or software program shall be provided to the owner. The owner shall be free to contract with any vendor or contractor for future service, expansion and/or modifications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide a Facility Management Control System (FMCS) based on the Tridium Niagara Network Area Controller (NAC) and the Honeywell Spyder Interoperable Digital Controller/Interoperable BACnet Controller (IDC/IBC). The Honeywell Spyder Interoperable Digital Controller Interoperable BACnet Controller (IDC/IBC) shall be fully programmable via the embedded Niagara WorkBench tool requiring only a web browser.

2.2 INSTALLERS

A. Any approved Honeywell/Tridium Niagara certified installer.

2.3 CONTROL SYSTEM

A. The Facility Management and Control System (FMCS) as provided in this Division shall be based on the Tridium Niagara System incorporating the Niagara Framework™. Equivalent products must be approved in writing by the consulting Engineer and be submitted for approval ten (10) days prior to the date of the bid submittal. Systems not developed on the Niagara Framework platform are unacceptable.

B. The entire Temperature Control System (TCS) shall be comprised of a network of interoperable, stand-alone digital controllers communicating via LON communication protocols to a Network Area Controller (NAC). Temperature Control System products shall be manufactured by Honeywell. Equivalent LON products must be approved in writing by the consulting Engineer and be submitted for approval ten (10) days prior to the date of the bid submittal.

C. B.The installed system shall provide secure password access to all features, functions and data contained in the overall FMCS.

2.4 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES

A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate ANSI/ASHRAE Standard 135-2001 BACnet, LonWorks technology, MODBUS, OPC, and other open and proprietary communication protocols in one open, interoperable system.

B. The supplied NAC and IDC/IBC shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI / ASHRAE™ Standard 135-2001, BACnet and Lonmark to assure interoperability between all system components is required. Devices that do not have Lonmark certification are not acceptable. For each BACnet device, the device supplier must provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet (BACnet Ethernet/IP,) and/or RS-485 (BACnet MSTP) as specified.

C. All components and controllers supplied under this Division shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.

D. The supplied system must incorporate the ability to access all data using standard Web browser without requiring proprietary operator interface and configuration software or licenses. No installed software or license shall be required to view, modify or program the Niagara NAC OR the IDC/IBC field controllers. All engineering shall be performed by use of the embedded Niagara WorkBench tool utilizing only a web browser such as Microsoft's Windows Explorer or Mozilla's Fire-Fox web browser. Systems requiring proprietary database, interface programs and or configuration software shall not be acceptable.

E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.
   1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
   2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.5 NETWORKS

A. The Local Area Network (LAN) shall be a 100 Megabits/sec Ethernet network supporting LonWorks, BACnet, Java, XML, HTTP, and SOAP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Network Area Controllers (NACs), user workstations and, if specified, a local server.

B. Local area network minimum physical and media access requirements:
   1. 1. Ethernet; IEEE standard 802.3
   2. 2. Cable; 100 Base-T, UTP-8 wire, category 5e
   3. 3. Minimum throughput; 100 Mbps.

2.6 NETWORK ACCESS

A. Remote Access.

1. For Local Area Network installations, provide access to the LAN from a remote location, via the Internet (if desired). The Owner shall provide a connection to the Internet to enable this access via high-speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer's Intranet to a corporate server providing access to an Internet Service Provider (ISP). Customer agrees to pay monthly access charges for connection and ISP (if required).

2.7 NETWORK AREA CONTROLLER (NAC)

A. The Division 17 contractor shall supply one or more Network Area Controllers (NAC) as part of this contract. Number of area controllers required is dependent on the type and quantity of devices provided under Divisions 15 and 16. It is the responsibility of the Division 17 contractor to coordinate with the Division 15 and 16 contractors to determine the quantity and type of devices.

B. The Network Area Controller (NAC) shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NAC. It shall be capable of executing application control programs to provide:
   1. Calendar functions
   2. Scheduling
   3. Trending
   4. Alarm monitoring and routing
   5. Time synchronization
   6. Integration of LonWorks controller data and BACnet controller data
   7. Network Management functions for all LonWorks based devices

C. The Network Area Controller must provide the following hardware features as a minimum:
   1. Two (2) Ethernet Ports – 10/100 Mbps
   2. One (1) RS-232 port
   3. One (1) LonWorks Interface Port – 78KB FTT-10A
   4. One (1) RS-485 ports
   5. Battery Backup
   6. Flash memory for long-term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
   7. The NAC must be capable of operation over a temperature range of 32 to 122°F
   8. The NAC must be capable of withstanding storage temperatures of between 0 and 158°F
   9. The NAC must be capable of operation over a humidity range of 5 to 95% RH, non-condensing

D. The NAC shall provide multiple user access to the system and support for ODBC or SQL (if specified). A database resident on the NAC shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read trend history data stored within it.

E. The NAC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 32 simultaneous users.

F. Event Alarm Notification and actions

1. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
2. The NAC shall be able to route any alarm condition to any defined user location whether connected to a local network or wide-area network or via email.
3. Alarm generation shall be selectable for annunciation type and acknowledgment requirements including but limited to:
   a. To alarm
   b. Return to normal
   c. To fault
4. Provide for the creation of a minimum of eight of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.
5. Provide timed (schedule) routing of alarms by class, object, group, or node.
6. Provide capability for alarm generation from binary object "runtime" and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.

G. Control equipment and network failures shall be treated as alarms and annunciated.

H. Alarms shall be annunciated in any of the following manners as defined by the user:
   1. Screen message text
   2. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
      a. Day of week
      b. Time of day
      c. Recipient
   3. Pagers via paging services that initiate a page on receipt of email message
   4. Graphic with flashing alarm object(s)
   5. Printed message, routed directly to a dedicated alarm printer

I. The following shall be recorded by the NAC for each alarm (at a minimum):
   1. Time and date
   2. Location (building, floor, zone, office number, etc.)
   3. Equipment (air handler #, accessway, etc.)
   4. Acknowledge time, date, and user who issued acknowledgement.
   5. Number of occurrences since last acknowledgement.

J. Alarm actions may be initiated by user defined programmable objects created for that purpose.

K. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.

L. A log of all alarms shall be maintained by the NAC and/or a server (if configured in the system) and shall be available for review by the user.

M. Provide a "query" feature to allow review of specific alarms by user defined parameters.

N. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

O. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

2.8 Data Collection and Storage

A. The NAC shall have the ability to collect data for any property of any object and store this data for future use.

B. The data collection shall be performed by trend history extensions, resident in the NAC that shall have, at a minimum, the following configurable properties:
1. Designating the log as interval or deviation.
2. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
3. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.

C. All log data shall be stored in a relational database in the NAC and the data shall be accessed from a server (if the system is so configured) or a standard Web browser or via a web Excel query.

D. All log data, when accessed from a server, shall be capable of being manipulated using standard BQL statements.

E. All log data shall be available to the user in the following data formats:
1. Niagara table or chart viewer.
2. OBIX
3. XML
4. Pdf
5. Excel Comma or tab separated values (csv)

F. Systems that do not provide log data in a RDBMS and csv formats at a minimum shall not be acceptable.

G. The NAC shall have the ability to archive its log data either locally (to itself), or remotely to a server or other NAC on the network. Provide the ability to configure the following archiving properties, at a minimum:
1. Archive on time of day
2. Auto archive when a Web-Supervisor archive is being reviewed by a user (Live History)

2.9 AUDIT LOG

A. Provide and maintain an Audit Log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:
1. Time and date

2. User ID
3. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

2.10 DATABASE BACKUP AND STORAGE

A. The NAC shall have the ability to automatically backup its database. The database shall be backed up once a day at a minimum.

B. Copies of the current database and, at the most recently saved database shall be stored in the NAC. The age of the most recently saved database is dependent on the user-defined database save interval.

C. The NAC database shall be archived to a Web-Supervisor (if present) on a monthly basis for extended system back-up, additionally an admin user shall be able to back-up the NAC database to his/her PC via a standard web browser.

2.11 INTEROPERABLE DIGITAL CONTROLLER (IBC)

A. ADVANCED UNITARY CONTROLLER
1. The controller platform shall be designed specifically to control HVAC – ventilation, filtration, heating, cooling, humidification, and distribution. Equipment includes: constant volume air handlers, VAV air handlers, packaged RTU, heat pumps, unit vents, fan coils, natural convection units, and radiant panels. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara AX Framework™, that allow standard and customizable control solutions required in executing the "Sequence of Operation" as outlined in Section 4.
2. Minimum Requirements:
   a. The controller shall be capable of either integrating with other devices or stand-alone operation.
   b. The controller shall have two microprocessors. The Host processor contains on-chip FLASH program memory, FLASH information memory, and RAM to run the main HVAC application. The second processor for BACnet® network communications.
      1) FLASH Memory Capacity: 372 Kilobytes with 8 Kilobytes for application program.
      2) FLASH Memory settings retained for ten years.
      3) RAM: 8 Kilobytes
   c. The controller shall have an internal time clock with the ability to automatically revert from a master time clock on failure.
      1) Operating Range: 24 hour, 365 day, multi-year calendar including day of week and configuration for automatic day-light savings time adjustment to occur on configured start and stop dates.
      2) Accuracy: ±1 minute per month at 77° F (25° C).
      3) Power Failure Backup: 24 hours at 32° to 100° F (0° to 38° C), 22 hours at 100° to 122° F (38° to 50° C).
   d. The controller shall include Sylk Bus, a two wire, polarity insensitive bus that provides both 18 Vdc power and communications between a Sylk-enabled device and a Sylk-enabled controller.

e. The controller shall have an internal DC power supply to power external sensors.
   1) Power Output: 20 VDC ±10% at 75 mA.
f. The controller shall have a visual indication (LED) of the status of the device:
   1) Controller operating normally.
   2) Controller in process of download.
   3) Controller is in reflash mode
   4) No power to controller, low voltage, or controller damage.
   5) Processor and/or controller are not operating.
g. The controller shall have a visual indication (LED) of the BACnet MS/TP communication status of the device:
   1) Processor missing bootloader image.
   2) Bootloader running and no MS/TP token present.
   3) Bootloader running and there is MS/TP communication.
   4) BACnet communications processor is not running
h. The minimum controller Environmental ratings
   1) Operating Temperature Ambient Rating: -40° to 150° F (-40° to 65.5° C).
   2) Storage Temperature Ambient Rating: -40° to 150° F (-40° to 65.5° C).
   3) Relative Humidity: 5% to 95% non-condensing.
i. The controller shall have the additional approval requirements, listings, and approvals:
   1) UL/cUL (E87741) listed under UL916 (Standard for Open Energy Management Equipment) with plenum rating.
   2) BACnet Application Specific Controller (B-ASC)
   3) CSA (LR95329-3) Listed
   4) Meets FCC Part 15, Subpart B, Class B (radiated emissions) requirements.
   5) Meets Canadian standard C108.8 (radiated emissions).
   6) Conforms to the following requirements per European Consortium standards:
      EN 61000-6-1; 2001 (EU Immunity)
      EN 61000-6-3; 2001 (EU Emissions)
j. The controller housing shall be UL plenum rated mounting to either a panel or DIN rail (standard EN50022; 7.5mm x 35mm).
k. The controller shall have sufficient on-board inputs and outputs to support the application.
   1) Analog outputs (AO) shall be capable of being configured to support 0-10 V, 2-10 V or 4-20 mA devices.
   2) Triac outputs shall be capable of switching 30 Volts at 500 mA.
   3) Input and Output wiring terminal strips shall be removable from the controller without disconnecting wiring. Input and Output wiring terminals shall be designated with color-coded labels.
   4) Universal inputs shall be capable of being configured as binary inputs, resistive inputs, voltage inputs (0-10 VDC), or current inputs (4-20 mA).
l. The controller shall provide "continuous" automated loop tuning with an Adaptive Integral Algorithm Control Loop.
m. The controller platform shall have standard HVAC application programs that are modifiable to support both the traditional and specialized "sequence of operations" as outlined in Section 4.
   1) Discharge air control and low limit
   2) Pressure-dependent dual duct without flow mixing.
   3) Variable air volume with return flow tracking.

4) Economizer with differential enthalpy.
5) Minimum airflow coordinated with CO2.
6) Unit ventilator cycle (1,2,3) 2-pipe.
7) Unit ventilator cycle (1,2,3) 2-pipe with face/bypass.

B. ADVANCED VARIABLE AIR VOLUME CONTROLLER

1. The controller platform shall be designed specifically for room-level VAV control – pressure-independent air flow control, pressure dependent damper control, supply and exhaust pressurization/de-pressurization control; temperature, humidity, complex CO2, occupancy, and emergency control. Equipment includes: VAV terminal unit, VAV terminal unit with reheat, Series fan powered terminal unit, Parallel fan powered terminal unit, Supply and Exhaust air volume terminals, and Constant volume dual-duct terminal unit. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara AX Framework™, that allow standard and customizable control solutions required in executing the "Sequence of Operation" as outlined in Section 4.
2. Minimum Requirements:
   a. The controller shall be capable of either integrating with other devices or stand-alone room-level control operation.
   b. The controller shall have an internal velocity pressure sensor.
      1) Sensor Type: Microbridge airflow sensor with dual integral restrictors.
      2) Operating Range: 0 to 1.5 in. H2O (0 to 374 Pa).
   c. The controller shall have two microprocessors. The Host processor contains on-chip FLASH program memory, FLASH information memory, and RAM to run the main HVAC application. The second processor for BACnet® network communications.
      1) FLASH Memory Capacity: 372 Kilobytes with 8 Kilobytes for application program.
      2) FLASH Memory settings retained for ten years.
      3) RAM: 8 Kilobytes
   d. The controller shall have an internal time clock with the ability to automatically revert from a master time clock on failure.
      1) Operating Range: 24 hour, 365 day, multi-year calendar including day of week and configuration for automatic day-light savings time adjustment to occur on configured start and stop dates.
      2) Accuracy: ±1 minute per month at 77° F (25° C).
      3) Power Failure Backup: 24 hours at 32° to 100° F (0° to 38° C), 22 hours at 100° to 122° F (38° to 50° C).
   e. The controller shall include Sylk Bus, a two wire, polarity insensitive bus that provides both 18 Vdc power and communications between a Sylk-enabled device and a Sylk-enabled controller.
   f. The controller shall have an internal DC power supply to power external sensors.
      1) Power Output: 20 VDC ±10% at 75 mA.
   g. The controller shall have a visual indication (LED) of the status of the devise:
      1) Controller operating normally.
      2) Controller in process of download.
      3) Controller is in reflash mode
      4) No power to controller, low voltage, or controller damage.
      5) Processor and/or controller are not operating.

h. The controller shall have a visual indication (LED) of the BACnet MS/TP communication status of the device:
   1) Processor missing bootloader image.
   2) Bootloader running and no MS/TP token present.
   3) Bootloader running and there is MS/TP communication.
   4) BACnet communications processor is not running

i. The minimum controller Environmental ratings:
   1) Operating Temperature Ambient Rating: 32° to 122° F (0° to 50° C).
   2) Storage Temperature Ambient Rating: -40° to 122° F (-40° to 50° C).
   3) Relative Humidity: 5% to 95% non-condensing.

j. The controller shall have the additional approval requirements, listings, and approvals:
   1) UL/cUL (E87741) listed under UL916 (Standard for Open Energy Management Equipment) with plenum rating.
   2) BACnet Application Specific Controller (B-ASC)
   3) CSA (LR95329-3) Listed
   4) Meets FCC Part 15, Subpart B, Class B (radiated emissions) requirements.

k. The controller housing shall be UL plenum rated mounting to either a panel or DIN rail (standard EN50022; 7.5mm x 35mm).

l. The controller shall provide an integrated actuator option.
   1) Actuator type: Series 60 Floating.
   2) Rotation stroke: 95° ±3° for CW or CCW opening dampers.
   3) Torque rating: 44 lb-in. (5 Nm).
   4) Run time for 90° rotation: 90 seconds at 60 Hz.

m. The controller shall have sufficient on-board inputs and outputs to support the application.
   1) Analog outputs (AO) shall be capable of being configured to support 0-10 V, 2-10 V or 4-20 mA devices.
   2) Triac outputs shall be capable of switching 30 Volts at 500 mA.
   3) Input and Output wiring terminal strips shall be removable from the controller without disconnecting wiring. Input and Output wiring terminals shall be designated with color-coded labels.
   4) Universal inputs shall be capable of being configured as binary inputs, resistive inputs, voltage inputs (0-10 VDC), or current inputs (4-20 mA).

n. The controller shall provide continuous automated loop tuning with an Adaptive Integral Algorithm Control Loop.

o. The controller shall have a loop execution response time of 1 second.

p. The controller platform shall have standard HVAC application programs that are modifiable to support both the traditional and specialized "sequence of operations" as outlined in Section 23 09 93.
   1) VAV terminal unit.
   2) VAV terminal unit fan speed control.
   3) Series fan.
   4) Parallel fan.
   5) Regulated air volume (room pressurization/de-pressurization).
   6) CV dual-duct
   7) Room CO2 control
   8) Room Humidity
   9) TOD occupancy sensor stand-by setpoints

C. HVAC control shall be accomplished using BACnet based devices. The Division 15 contractor shall provide all programming, documentation and programming tools necessary to set up and configure the supplied devices per the specified sequences of operation.

D. The Division 23 contractor shall run the BACnet network trunk to the nearest Network Area Controller (NAC). Coordinate locations of the NAC to ensure that maximum network wiring distances, as specified by the BACnet wiring guidelines, are not exceeded. A maximum of 30 devices may occupy any one BACnet trunk and must be installed using the appropriate trunk termination device.

E. The Network Area Controller (NAC) will provide all scheduling, alarming, trending, and network management for the BACnet based devices.

F. The IBCs shall communicate with the NAC at a baud rate of not less than 38.4K baud. The IBC shall provide LED indication of communication and controller performance to the technician.

G. All IBCs shall be fully application programmable and shall at all times maintain their BACnet BTL certification. Controllers offering application selection only (non-programmable), require a 10% spare point capacity to be provided for all applications. All control sequences within or programmed into the IBC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.

H. The Division 15 contractor supplying the IBC's shall provide documentation for each device, with the following information at a minimum:
   1. Analog In
   2. Analog Out
   3. Analog Value
   4. Binary
   5. Binary In
   6. Binary Out
   7. Binary Value
   8. Multi-State In
   9. Multi-State Out
   10. Multi-State Value
   11. Schedule object
   12. Calendar object

I. It is the responsibility of the Division 15 contractor to ensure that the proper BACnet objects are provided in each IBC, as required by the project.

J. The supplier of any programmable IBC shall provide one copy of the manufacturer's programming tool, with documentation, to the owner.

2.12 FLOW MEASURING STATIONS

A. Duct Airflow Station: Combination of air straightener and multiport, self-averaging pitot tube station.

   1. <u>Manufacturers</u>:

a. Air Monitor Corporation.
b. Wetmaster Co., Ltd.
c. Engineer approved

2. Casing: Galvanized-steel frame.
3. Flow Straightener: Aluminum honeycomb, 3/4-inch parallel cell, 3 inches deep.
4. Sensing Manifold: Copper manifold with bullet-nosed static pressure sensors positioned on equal area basis.

2.13 GRAPHICAL USER INTERFACE

A. Operating System:
1. The GUI shall be a standard web browser such as Microsoft Internet Explorer or Mozilla Fire-Fox.
2. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.
3. Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:
   a. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.
   b. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.
   c. Graphics shall support layering and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.
   d. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.
      1) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
      2) Holidays shall be set by using a graphical calendar without requiring any keyboard entry from the operator.
   e. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu.
   f. Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a override value input box to adjust the value.

B. System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:
1. Create, delete or modify control strategies.
2. Add/delete objects to the system.

3. Tune control loops through the adjustment of control loop parameters.
4. Enable or disable control strategies.
5. Generate hard copy records or control strategies on a printer.
6. Enable/disable points to be alarmed and define the alarm name, state or value, time delays etc.
7. Enable/disable points to be trended over a period of time and adjust trending parameters and names.

C. Security. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.

D. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.

E. Alarm Console
1. The system will be provided with a web browser based alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm.
2. An optional Alarm Console Service can be used to provide continuous alarm notification and monitoring by means of an alarm window that will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable. The Alarm Console Service is an option that can be installed on any PC for continuous alarm monitoring for a single site, or from multiple sites.

2.14 WEB BROWSER CLIENTS

A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™ or Mozilla Fire Fox™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.

B. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the FMCS, shall not be acceptable.

C. The Web browser client shall support at a minimum, the following functions:
1. User log-on identification and password shall be required. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.

2. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
3. Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
4. Real-time values displayed on a Web page shall update automatically without requiring a manual "refresh" of the Web page.
5. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
   a. Modify common application objects, such as schedules, calendars, and set points in a graphical manner.
      1) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
      2) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
   b. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu.
   c. View logs and charts
   d. View and acknowledge alarms
6. The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
   a. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

2.15 Web-Supervisor SERVER FUNCTIONS AND HARDWARE

A. A central server, located (in, at)Board of Education shall be provided. The server shall support all Network Area Controllers (NAC) connected to the customer's network whether local or remote.

B. Local connections shall be via an Ethernet LAN. Remote connections can be via ISDN, ADSL, T1 or dial-up connection.

C. It shall be possible to provide access to all Network Area Controllers via a single connection to the server. In this configuration, each Network Area Controller can be accessed from a remote Graphical User Interface (GUI) or from a standard Web browser (WBI) by connecting to the server.

D. The server shall provide the following functions, at a minimum:
   1. Global Data Access: The server shall provide complete access to distributed data defined anywhere in the system.
   2. Distributed Control: The server shall provide the ability to execute global control strategies based on control and data objects in any NAC in the network, local or remote.
   3. The server shall include a master clock service for its subsystems and provide time synchronization for all Network Area Controllers (NAC).

4. The server shall accept time synchronization messages from trusted precision Atomic Clock Internet sites and update its master clock based on this data.
5. The server shall provide master scheduling for all Network Area Controllers and their underlying field control devices.
6. The server shall provide demand limiting that operates across all Network Area Controllers. The server must be capable of multiple demand programs for sites with multiple meters and or multiple sources of energy. Each demand program shall be capable of supporting separate demand shed lists for effective demand control.
7. The server shall implement priority array command prioritization scheme (16 levels) for safe and effective contention resolution of all commands issued to Network Area Controllers. Systems not employing this prioritization shall not be accepted.
8. Each Network Area Controller supported by the server shall have the ability to archive its log data, alarm data and database to the server, automatically. Archiving options shall be user-defined including archive time and archive frequency.
9. The server shall provide central alarm management for all Network Area Controllers supported by the server. Alarm management shall include:
   a. Routing of alarms to display, printer, email and pagers
   b. View and acknowledge alarms
   c. Query alarm logs based on user-defined parameters
10. The server shall provide central management of log data for all Network Area Controllers supported by the server. Log data shall include process logs, runtime and event counter logs, audit logs and error logs. Log data management shall include:
    a. Viewing and printing log data
    b. Exporting log data to other software applications
    c. Query log data based on user-defined parameters

E. Server Hardware Requirements: The server hardware platform shall have the following requirements:
1. The computer shall be an Intel Core i5 based computer (minimum processing speed of 3.3 GHz with 4 GB RAM and a 500-gigabyte minimum hard drive). It shall include a 16X DVD +/-RW Combination Drive, 4-USB ports. A minimum 17" flat panel color monitor, 1280 x 1024 optimal preset resolution, 25 ms response time shall also be included.
2. The server operating system shall be Microsoft Windows 7 Professional.
3. Connection to the FMCS network shall be via an Ethernet network interface card, 100 Mbps.
4. A system printer shall be provided. Printer shall be laser type with a minimum 600 x 600-dpi resolution and rated for 35-PPM print speed minimum.

2.16 SYSTEM PROGRAMMING

A. The Graphical User Interface software (GUI) shall provide the ability to perform system programming and graphic display engineering as part of a complete software package. Access to the programming functions and features of the GUI shall be through password access as assigned by the system administrator.

B. A library of control, application, and graphic objects shall be provided to enable the creation of all applications and user interface screens. Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking

them together using a built in graphical connection tool. Completed applications may be stored in the library for future use. Graphical User Interface screens shall be created in the same fashion. Data for the user displays is obtained by graphically linking the user display objects to the application objects to provide "real-time" data updates. Any real-time data value or object property may be connected to display its current value on a user display. Systems requiring separate software tools or processes to create applications and user interface displays shall not be acceptable.

C. Programming Methods

1. Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user's application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links will vary in color depending on the type of link; i.e., internal, external, hardware, etc.
2. Configuration of each object will be done through the object's property sheet using fill-in the blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration will not be accepted.
3. The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.
4. The system shall support object duplication within a customer's database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.

2.17 LonWorks NETWORK MANAGEMENT

A. The Graphical User Interface software (GUI) shall provide a complete set of integrated LonWorks network management tools for working with LonWorks networks. These tools shall manage a database for all LonWorks devices by type and revision, and shall provide a software mechanism for identifying each device on the network. These tools shall also be capable of defining network data connections between LonWorks devices, known as "binding". Systems requiring the use of third party LonWorks network management tools shall not be accepted.

B. Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.

C. The network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices, and to view health and status counters within devices.

D. These tools shall provide the ability to "learn" an existing LonWorks network, regardless of what network management tool(s) were used to install the existing network, so that existing LonWorks devices and newly added devices are part of a single network management database.

E. The network management database shall be resident in the Network Area Controller (NAC), ensuring that anyone with proper authorization has access to the network management database at all times. Systems employing network management databases that are not resident, at all times, within the control system, shall not be accepted.

2.18 OBJECT LIBRARIES

A. A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.

B. The objects in this library shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.

C. In addition to the standard libraries specified here, the supplier of the system shall maintain an on-line accessible (over the Internet) library, available to all registered users to provide new or updated objects and applications as they are developed.

D. All control objects shall conform to the control objects specified in the BACnet specification.

E. The library shall include applications or objects for the following functions, at a minimum:
   1. Scheduling Object. The schedule must conform to the schedule object as defined in the BACnet specification, providing 7-day plus holiday & temporary scheduling features and a minimum of 10 on/off events per day. Data entry to be by graphical sliders to speed creation and selection of on-off events.
   2. Calendar Object. The calendar must conform to the calendar object as defined in the BACnet specification, providing 12-month calendar features to allow for holiday or special event data entry. Data entry to be by graphical "point-and-click" selection. This object must be "linkable" to any or all scheduling objects for effective event control.
   3. Duty Cycling Object. Provide a universal duty cycle object to allow repetitive on/off time control of equipment as an energy conserving measure. Any number of these objects may be created to control equipment at varying intervals
   4. Temperature Override Object. Provide a temperature override object that is capable of overriding equipment turned off by other energy saving programs (scheduling, duty cycling etc.) to maintain occupant comfort or for equipment freeze protection.
   5. Start-Stop Time Optimization Object. Provide a start-stop time optimization object to provide the capability of starting equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled un-occupancy time just far enough ahead to take advantage of the building's "flywheel" effect for energy savings. Provide automatic tuning of all start / stop time object properties based on the previous day's performance.
   6. Demand Limiting Object. Provide a comprehensive demand-limiting object that is capable of controlling demand for any selected energy utility (electric, oil, and gas). The object shall provide the capability of monitoring a demand value and predicting (by use of a sliding window prediction algorithm) the demand at the end of the user defined interval period (1-60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user defined demand limit (supply a minimum of 6 per day), the demand limiting object shall

issue shed commands to either turn off user specified loads or modify equipment set points to effect the desired energy reduction. If the list of sheddable equipment is not enough to reduce the demand to below the set point, a message shall be displayed on the users screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand-limiting object shall restore the equipment that was shed in the reverse order in which it was shed. Each sheddable object shall have a minimum and maximum shed time property to effect both equipment protection and occupant comfort.

F. The library shall include control objects for the following functions. All control objects shall conform to the objects as specified in the BACnet specification.

1. Analog Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.
2. Analog Output Object - Minimum requirement is to comply with the BACnet standard for data sharing.
3. Binary Input Object - Minimum requirement is to comply with the BACnet standard for data sharing. The user must be able to specify either input condition for alarming. This object must also include the capability to record equipment run-time by counting the amount of time the hardware input is in an "on" condition. The user must be able to specify either input condition as the "on" condition.
4. Binary Output Object - Minimum requirement is to comply with the BACnet standard for data sharing. Properties to enable minimum on and off times for equipment protection as well as interstart delay must be provided. The BACnet Command Prioritization priority scheme shall be incorporated to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide sixteen levels of priority as a minimum. Systems not employing the BACnet method of contention resolution shall not be acceptable.
5. PID Control Loop Object - Minimum requirement is to comply with the BACnet standard for data sharing. Each individual property must be adjustable as well as to be disabled to allow proportional control only, or proportional with integral control, as well as proportional, integral and derivative control.
6. Comparison Object - Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked inputs. Also, allow limits to be applied to the output value for alarm generation.
7. Math Object - Allow a minimum of four analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value for alarm generation.
8. Interlock Object - Provide an interlock object that provides a means of coordination of objects within a piece of equipment such as an Air Handler or other similar types of equipment. An example is to link the return fan to the supply fan such that when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a user-defined period after startup to allow for stabilization. When the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and

other related objects within the air handler unit are inhibited from alarming thereby eliminating nuisance alarms during the off period.

9. Temperature Override Object - Provide an object whose purpose is to provide the capability of overriding a binary output to an "On" state in the event a user specified high or low limit value is exceeded. This object is to be linked to the desired binary output object as well as to an analog object for temperature monitoring, to cause the override to be enabled. This object will execute a Start command at the Temperature Override level of start/stop command priority unless changed by the user.

G. The object library shall include objects to support the integration of devices connected to the Network Area Controller (NAC). At a minimum, provide the following as part of the standard library included with the programming software:

1. LonMark/LonWorks devices. These devices shall include, but not be limited to, devices for control of HVAC, lighting, access, and metering. Provide LonMark manufacturer-specific objects to facilitate simple integration of these devices. All network variables defined in the LonMark profile shall be supported. Information (type and function) regarding network variables not defined in the LonMark profile shall be provided by the device manufacturer.
2. For devices not conforming to the LonMark standard, provide a dynamic object that can be assigned to the device based on network variable information provided by the device manufacturer. Device manufacturer shall provide an XIF file, resource file and documentation for the device to facilitate device integration.
3. For BACnet devices, provide the following objects at a minimum:
   a. Analog In
   b. Analog Out
   c. Analog Value
   d. Binary
   e. Binary In
   f. Binary Out
   g. Binary Value
   h. Multi-State In
   i. Multi-State Out
   j. Multi-State Value
   k. Schedule Export
   l. Calendar Export
   m. Trend Export
   n. Device
4. For each BACnet object, provide the ability to assign the object a BACnet device and object instance number.
5. For BACnet devices, provide the following support at a minimum
   a. Segmentation
   b. Segmented Request
   c. Segmented Response
   d. Application Services
   e. Read Property
   f. Read Property Multiple
   g. Write Property
   h. Write Property Multiple
   i. Confirmed Event Notification
   j. Unconfirmed Event Notification

k. Acknowledge Alarm
l. Get Alarm Summary
m. Who-has
n. I-have
o. Who-is
p. I-am
q. Subscribe COV
r. Confirmed COV notification
s. Unconfirmed COV notification
t. Media Types
u. Ethernet
v. BACnet IP Annex J
w. MSTP
x. BACnet Broadcast Management Device (BBMD) function
y. Routing

2.19 DDE DEVICE INTEGRATION

A. A.The Network Area Controller shall support the integration of device data via Dynamic Data Exchange (DDE), over the Ethernet Network. The Network Area Controller shall act as a DDE client to another software application that functions as a DDE server.

B. B.Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of these devices into the FMCS. Objects provided shall include at a minimum:

C. 1. DDE Generic AI Object

D. 2. DDE Generic AO Object

E. 3. DDE Generic BO Object

F. 4. DDE Generic BI Object

2.20 MODBUS SYSTEM INTEGRATION

A. The Network Area Controller shall support the integration of device data from Modbus RTU, Ascii, or TCP control system devices. The connection to the Modbus system shall be via an RS-232, RS485, or Ethernet IP as required by the device.

B. Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of the Modbus system data into the FPMS. Objects provided shall include at a minimum:
1. Read/Write Modbus AI Registers
2. Read/Write Modbus AO Registers
3. Read/Write Modbus BI Registers
4. Read/Write Modbus BO Registers

C. All scheduling, alarming, logging and global supervisory control functions, of the Modbus system devices, shall be performed by the Network Area Controller.

D. The FMCS supplier shall provide a Modbus system communications driver. The equipment system vendor that provided the equipment utilizing Modbus shall provide documentation of the system's Modbus interface and shall provide factory support at no charge during system commissioning

2.21 OPC SYSTEM INTEGRATION

A. The Network Area Controller shall act as an OPC client and shall support the integration of device data from OPC servers. The connection to the OPC server shall be Ethernet IP as required by the device. The OPC client shall support third party OPC servers compatible with the Data Access 1.0 and 2.0 specifications.

B. Provide the required objects in the library, included with the Graphical User Interface programming software, to support the integration of the OPC system data into the BAS. Objects provided shall include at a minimum:
1. Read/Write OPC AI Object
2. Read/Write OPC AO Object
3. Read/Write OPC BI Object
4. Read/Write OPC BO Object
5. Read/Write OPC Date/Time Input Object
6. Read/Write OPC Date/Time Output Object
7. Read/Write OPC String Input Object
8. Read/Write OPC String Output Object

C. All scheduling, alarming, logging and global supervisory control functions, of the OPC system devices, shall be performed by the Network Area Controller.

D. The FMCS supplier shall provide an OPC client communications driver. The equipment system vendor that provided the equipment utilizing OPC shall provide documentation of the system's OPC server interface and shall provide factory support at no charge during system commissioning.

2.22 OTHER CONTROL SYSTEM HARDWARE

A. Space Temperature Wall Module. Wall Module shall be Honeywell or equivalent.
1. Wall module shall have a 20K Ohm NTC thermistor temperature sensor with operating range of 45 to 99 F under a locking cover/enclosure with UL 916 listing designed for mounting on a standard electrical switch box.
2. Space temperature sensors shall be accurate to plus or minus one F degree.
3. Where specified, space temperature sensors shall have a setpoint knob calibrated for warmer-cooler adjustments (option: calibrated to allow plus or minus adjustments to a software setpoint).
4. Where specified, wall module shall also have an after-hours override pushbutton and LED override indicator.

5. Where specified, the wall module shall have a fan coil unit fan control switch for (auto-off-on) (auto-off-low-med-hi) fan control. The wall module function is further specified in SECTION III Sequence of Operation.

B. Standard Automatic Control Dampers. Dampers shall be Honeywell or equivalent. Provide all automatic control dampers not specified to be integral with other equipment.
   1. Frames shall be 5 inches wide and of no less than 16-gauge galvanized steel. Inter-blade linkage shall be within the frame and out of the air stream.
   2. Blades shall not be over 8 inches wide nor less than 16-gauge galvanized steel triple V type for rigidity.
   3. Bearings shall be acetyl, oilite, nylon or ball-bearing with ½ inch diameter plated steel shafts.
   4. Dampers shall be suitable for temperature ranges of -40 to 180F.
   5. All proportional control dampers shall be opposed or parallel blade type as hereinafter specified and all two-position dampers shall be parallel blade types.
   6. Dampers shall be sized to meet flow requirements of the application. The sheet metal contractor shall furnish and install baffles to fit the damper to duct size. Baffles shall not exceed 6". Dampers with dimensions of 24 inches and less shall be rated for 3,000 fpm velocity and shall withstand a maximum system pressure of 5.0 in. w.c. Dampers with dimensions of 36 inches and less shall be rated for 2,500 fpm velocity and shall withstand a maximum system pressure of 4.0 in. w.c. Dampers with dimensions of 48 inches and less shall be rated for 2,000 fpm velocity and shall withstand a maximum system pressure of 2.5 in. wc. Damper blade width shall be no greater than 8 inches, and dampers over 48 inches wide by 74 inches high shall be sectionalized.
   7. Maximum leakage for dampers in excess of sixteen inches square shall be 30 CFM per square foot at static pressure of 1 inch of WC. Testing and ratings to be in accordance with AMCA Standard 500.

C. Low Leakage Automatic Control Dampers. Dampers shall be Honeywell or equivalent. Provide all automatic control dampers not specified to be integral with other equipment.
   1. Frames shall be 5 inches wide and of no less than 16-gauge galvanized steel. Inter-blade linkage shall be within the frame and out of the air stream.
   2. Blades shall not be over 8 inches wide nor less than 16-gauge galvanized steel triple V type for rigidity.
   3. Bearings shall be acetyl, oilite, nylon or ball-bearing with ½ inch diameter plated steel shafts.
   4. Dampers shall be suitable for temperature ranges of -40 to 180F.
   5. All proportional control dampers shall be opposed or parallel blade type as hereinafter specified and all two-position dampers shall be parallel blade types.
   6. Dampers shall be sized to meet flow requirements of the application. The sheet metal contractor shall furnish and install baffles to fit the damper to duct size. Baffles shall not exceed 6". Dampers with dimensions of 24 inches and less shall be rated for 3,000 fpm velocity and shall withstand a maximum system pressure of 5.0 in. w.c. Dampers with dimensions of 36 inches and less shall be rated for 2,500 fpm velocity and shall withstand a maximum system pressure of 4.0 in. wc. Dampers with dimensions of 48 inches and less shall be rated for 2,000 fpm velocity and shall withstand a maximum system pressure of 2.5 in. w.c.
   7. Side seals shall be stainless steel of the tight-seal spring type.

8. Dampers shall be minimum leakage type to conserve energy and the temperature control manufacturer shall submit leakage data for all low leakage control dampers with the temperature control submittal.
9. Maximum leakage for low leakage dampers in excess of sixteen inches square shall be 8 CFM per square foot at static pressure of 1 inch of WC.
10. Low leakage damper blade edges shall be fitted with replaceable, snap-on, inflatable seals to limit damper leakage.
11. Testing and ratings shall be in accordance with AMCA Standard 500.
12. Damper blade width shall be no greater than 8 inches, and dampers over 48 inches wide by 74 inches high shall be sectionalized. Testing and ratings to be in accordance with AMCA Standard 500.

D. Round Motorized Dampers. Dampers shall be Honeywell or equivalent. Round dampers shall be provided where specified and shall be factory mounted in a section of round duct a minimum of 12 inches long, but no less than one inch longer than the duct diameter.
1. Duct shall be sleeve type spiral duct crimped on the downstream end, 24 gage galvanized minimum except duct over 12 inches in diameter shall be 22 gage.
2. Duct shall have an integral galvanized steel actuator mounting plate and a ½ inch zinc-coated steel blade shaft extending a minimum of 2 inches beyond the actuator mounting plate.
3. Shaft bearings shall be flanged bronze oilite pressed into the frame.
4. The blade shall be a minimum 16 gage galvanized steel, and damper frame shall be provided with closed-cell neoprene seals with silicone rubber bead. Damper shall be designed for a 2500 ft/min approach velocity and a 4 inch minimum static pressure.
5. Damper shall be suitable for operation from 32 to 130F temperatures.
6. Damper and actuator combination shall be designed for leakage rates less than 13 cfm per square foot at one-inch w.c differential and 25 cfm at four inches w.c. Actuator shall have an external declutch lever to allow manual blade positioning during equipment and power malfunctions.

E. Control Valves: (Globe Type) Valves shall be Honeywell or equivalent. Control valves shall be 2-way or 3-way pattern as shown constructed for tight shutoff and shall operate satisfactory against system pressures and differentials.
1. Two-position valves shall be 'line' size. Proportional control valves shall be sized for a maximum pressure drop of 5.0 psi at rated flow (except as may be noted on the drawings).
2. Two-way water valves shall have equal percentage flow characteristics and three-way valves shall have equal percentage flow characteristics straight through and linear through the bypass.
3. Provide valve position indicator on all valves. Leakage rate shall be no more than 0.05% of Cv.
4. Valves 1/2 inch through 1 1/2 inch shall be screwed pattern except where solder connections are specified for valves 1/2 or 3/4 inches.
5. Three-way valves bypass port shall be of one size reduced Cv to preclude the need for a bypass port balancing valve.
6. Valve and cartridge replacement tool shall be configured for maintenance or replacement without draining the coil to prevent water spill; however, an integral isolation valve on the control valve outlet will also be acceptable.
7. Valves shall close off against 58 psi minimum.

8. Two inch valves shall be "screwed" configuration and 2-1/2 inch and larger valves shall be "flanged" configuration and ANSI-rated to withstand the pressures and temperatures encountered.
9. Valves shall have stainless-steel stems and spring loaded Teflon packaging with replaceable discs.

F. Control Valves: (Characterized Ball Valves) Valves shall be Honeywell or equivalent. Control valves 1/2 to 2 inches shall be 2-way or 3-way forged brass screwed pattern as shown constructed for tight shutoff and shall operate satisfactory against system pressures and differentials.
1. Two-position valves shall be 'line' size. Proportional control valves shall be sized for a maximum pressure drop of 5.0 psi at rated flow (except as may be noted on the drawings).
2. Two-way water valves shall have equal percentage flow characteristics and three-way valves shall have equal percentage flow characteristics straight through and linear flow through the bypass.
3. Leakage rate shall be ANSI Class IV (no more than 0.01% of Cv).
4. Valves shall be rated for no less than 350 psig at no less than 250 degrees F.
5. Provide a removable handle to operate valves manually during actuator power loss or failure.
6. Two-way valves shall close off against 100 psi minimum, and three-way valves shall close off against 40 psi minimum.
7. Valves shall have stainless-steel or chemically nickel-plated brass stem and throttling port.
8. Valves shall be tagged with Cv rating and model number.

G. Butterfly Control Valves: Valves shall be Honeywell or equivalent. Where specified butterfly control valves over 2" in size shall be cast iron body type for 2-way or 3-way applications specified constructed for tight shutoff and shall operate satisfactory against system pressures and differentials.
1. Valves shall have tapped lugs for standard flange connection, and designed for isolation and removal of downstream piping at full rated pressure.
2. Two-position valves shall be 'line' size.
3. Proportional control valves shall be sized for a maximum pressure drop of 5.0 psi at rated flow (except as may be noted on the drawings).
4. Valves shall be rated for bubble tight shutoff at no less than 150 psi.
5. Valve disc shall be aluminum bronze.
6. Valve stems shall be stainless steel, with inboard top and bottom bronze bearings, and an external corrosion resistant top bearing to absorb actuator side thrust.

H. Duct Mount, Pipe Mount and Outside Air Temperature Sensors: Temperature sensors with an accuracy of + 0.3° F. Temperature sensors shall be Honeywell or equivalent.
1. Outside air sensors shall include an integral sun shield.
2. Duct sensors shall have sensor approximately in center of the duct, and shall have selectable lengths of 6, 12, and 18 inches.
3. 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).
4. Pipe mount sensors shall have copper, or stainless steel separable wells.

I. Current Sensitive Switches: Solid state, split core current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point shall be provided where specified. Current switches shall include an integral LED for indication of trip condition and a current level below trip set point.

J. Water Flow Meters: Water flow meters shall be axial turbine style flow meters which translate liquid motion into electronic output signals proportional to the flow sensed.
   1. Flow sensing turbine rotors shall be non-metallic and not impaired by magnetic drag.
   2. Flow meters shall be 'insertion' type complete with 'hot-tap' isolation valves to enable sensor removal without water supply system shutdown.
   3. Accuracy shall be + 2% of actual reading from 0.4 to 20 feet per second flow velocities.

K. Low Temperature Limit Switches. Limit switches shall be Honeywell or equivalent. Safety low limit shall be manual reset twenty foot limited fill type responsive to the coolest section of its length.

L. High Temperature Limit Switches. Limit and Safety switches shall be Honeywell or equivalent. Safety high limit (firestats) shall be manual reset type.

M. CO2 Sensors. CO2 sensors shall be Honeywell or equivalent.
   1. Carbon Dioxide sensors shall be 0-10 Vdc analog output type, with corrosion free gold-plated non-dispersive infrared sensing, designed for duct mounting.
   2. Sensor shall incorporate internal diagnostics for power, sensor, analog and output checking, and automatic background calibration algorithm for reduced maintenance. Sensor range shall be 0-2000 PPM with +/- 50 PPM accuracy.

N. Humidity Sensors. Humidity sensors shall be Honeywell or equivalent.
   1. Duct and room sensors shall have a sensing range of 5% to 95%.
   2. Duct sensors shall be provided with a sampling chamber.
   3. Outdoor air humidity sensors shall have a sensing range of 20% to 95% RH. They shall have a compensated ambient temperature range of -40°F to 170° F.

O. Enthalpy Sensors. Enthalpy sensors shall be Honeywell or equivalent. Duct mounted enthalpy sensor shall include a temperature sensor and a humidity sensor constructed to close an electrical contact upon a drop in enthalpy (total heat) to enable economizer modes of operation where specified.
   1. (OPTION - C7400 – Select one) Where specified provide duct mounted sensor including solid state temperature and humidity sensors with electronics which shall output a 4-20 ma signal input to the controller upon a varying enthalpy (total heat) to enable economizer modes of operation when outside air enthalpy is suitable for free cooling .

P. Annular Pitot Tube Flow Meter. Annular pitot tube shall be averaging type differential pressure sensors with four total head pressure ports and one static port made of austenitic stainless steel.
   1. Sensor shall have an accuracy of ± .25% of full flow and a repeatability of ± .05% of measured value.
   2. Transmitter shall be electronic and shall produce a linear output of 4 to 20 mAdc corresponding to the required flow span.
   3. The transmitter shall include noninteracting zero and span adjustments.
   4. Acceptable Manufacturers: Pitot Tube: Dieterich Annubar, Transmitter: Setra or Dieterich

Q. Variable Frequency Drives. Variable Frequency drives shall be Honeywell or equivalent.

1. Variable frequency drives shall be UL listed and sized for the power and loads applied.
2. Drives shall include built-in radio frequency interference (RFI) filters and be constructed to operate in equipment rooms and shall not be susceptible to electromagnetic disturbances typically encountered in such environments. Similarly, the drives must not excessively disturb the environment within which it is used.
3. All VFDs over 3 horsepower shall be provided with an AC choke.
4. VFDs shall be installed in strict conformance to the manufacturer's installation instructions, and shall be rated to operate over a temperature range of 14 to 104 F.
5. VFD automatic operation shall be suitable for an analog input signal compatible with the digital controller output.
6. Each VFD shall be fan cooled and have an integral keypad and alphanumeric display unit for user interface. The display shall indicate VFD status (RUN motor rotation, READY, STOP, ALARM, and FAULT), and shall indicate the VFD current control source (DDC input signal, keypad, or field bus control). In addition to the alphanumeric display, the display unit shall have three pilot lights to annunciate when the power is on (green), when the drive is running (green, blinks when stopping and ramping down), and when the drive was shut down due to a detected fault (red, fault condition presented on the alphanumeric display).
7. Three types of faults shall be monitored, "FAULT" shall shut the motor down, "FAULT Auto-reset" shall shut the motor down and try to restart it for a programmable number of tries, and "FAULT Trip" shall shut the motor down after a FAULT Auto-reset fails to restart the motor. Coded faults shall be automatically displayed for the following faults:

- Over current
- Over voltage
- Earth ground
- Emergency stop
- System (component failure)
- Under voltage
- Phase missing
- Heat sink under temperature
- Heat sink over temperature
- Motor stalled
- Motor over temperature
- Motor underload
- Cooling fan failure
- Inverter bridge over temperature
- Analog input control under current
- Keypad failure
- Other product unique monitored conditions

8. In addition to annunciating faults, at the time of fault occurrence the VFD shall capture and make available to the user certain system data for subsequent analysis during fault trouble shooting, including duration of operation (days, hours, minutes, seconds), output frequency, motor current, motor voltage, motor power, motor torque, DC voltage, unit temperature, run status, rotation direction, and any warnings. The last 30 fault occurrences shall be retained as well as the fault data listed in the previous sentence of each fault. New faults beyond 30 shall overwrite the oldest faults.
9. The display unit keypad shall allow setting operational parameters including minimum and maximum frequency, and acceleration and deceleration times. The display shall offer

user monitoring of frequency, unit temperature, motor speed, current, torque, power, voltage, and temperature.

R. Actuators, General. Actuators shall be Honeywell or equivalent. All automatically controlled devices, unless specified otherwise elsewhere, shall be provided with actuators sized to operate their appropriate loads with sufficient reserve power to provide smooth modulating action or two-position action and tight close-off. Valves shall be provided with actuators suitable for floating or analog signal control as required to match the controller output. Actuators shall be power failure return type where valves or dampers are required to fail to a safe position and where specified.

S. Non-Spring Return Low Torque Direct Coupled 35 & 70 lb-in Actuators. Actuators shall be Honeywell or equivalent. Actuators shall be 35 (ML 6161 or ML 7161) or 70 lb-in. (ML6174 or ML 7174) with strokes adjustable for 45, 60, or 90-degree rotation applications and designed for operation between 20 and 125 F.
   1. Each actuator shall also have a minimum position adjustable rotation of 0 to 30 degrees.
   2. Actuators shall be for floating or two position (ML 6161 or ML6174) control, or for 4-20 mA or 2-10Vdc (ML7161 or ML7174) input signals.
   3. Analog control actuators shall have a cover mounted direct/reverse acting switch.
   4. Actuator motor shall be magnetically coupled or shall have limit switch stops to disengage power at the ends of the stroke.
   5. Actuators shall be direct connected (no linkages) and provided with a manual declutch for manual positioning.
   6. Actuators shall have NEMA 1 environmental protection rating and be 24 volt and UL listed with UL94-5V plenum requirement compliance.
   7. Minimum design life of actuators shall be for 1,500,000 repositions and 35 lb-in. models shall be designed for 50,000 open-close cycles and 70 lb-in. models shall be designed for 40,000 open-close cycles.
   8. Actuator options shall include 1) Auxiliary feedback potentiometers, 2) open-closed indicator switches, 3) actuator timings of 90 seconds, 3 minutes, or 7 minutes, one or two auxiliary switches, and 4) torque of 35 or 70 lb-in.

T. Non-Spring Return High Torque 177 and 300 lb-in Actuators. MN6120A, MN6134A, MN7234A Series Actuators shall be UL listed 24 Vac in NEMA 2 enclosures designed for operation between -5 and 140 F.
   1. Rotation direction shall be switch selectable.
   2. Minimum design life of actuators shall be for 1,500,000 repositions and for 60,000 open-close cycles.
   3. Actuators shall be suitable for the controller output signals encountered, floating or analog, and shall have full cycle timing of 95 seconds.
   4. Actuators shall be direct connected (no linkages) and provided with a manual declutch for manual positioning.
      a. Actuators shall have 177 lb-in. torque with adjustable stroke, 30 to 90 degrees.

U. Spring Return Direct Coupled Actuators. Actuators shall have torque ratings of 44lb-in. (MS4105, MS7505, MS8105), 88 lb-in. (MS4110, MS7510, MS 8110), or 175 lb-in (MS4120, MS7520, MS8120). Actuators shall be Honeywell or equivalent. Actuators shall be modulating 90 seconds nominal timing or two-position 45 seconds nominal timing types with strokes for 90-degree rotation applications and designed for operation between -40 and 140 F

1. Each torque rating group shall have optionally selected control types, floating control, 2-position 24 Vac, 2-position line voltage, or analog input which is switch selectable as 0-10Vdc, 10-0 Vdc, 2-10 Vdc, or 10-2 Vdc.
2. Actuator spring return direction (open or closed) shall be easily reversed in the field, and actuators shall spring return in no greater than 20 seconds.
3. Actuators shall be direct connected (no linkages), and shall have integral position indication.
4. Actuators shall have NEMA 2 environmental protection rating, and UL approved and plenum rated per UL873.
5. Minimum design life of modulating actuators shall be for 1,500,000 repositions and 60,000 spring returns, except 2-position actuators shall be for 50,000 spring returns.
6. Each actuator shall be provided with a manual power-off positioning lever for manual positioning during power loss or system malfunctions, including a gear-train lock to prevent spring action.
7. Upon power restoration after gear lock, normal operation shall automatically recur.

V. Fast Acting Two Position Fire & Smoke Actuators (ML4115, ML8115). Actuators shall be Honeywell or equivalent. Fire/smoke damper actuators shall be direct connected (no linkages) two-position spring return types with stroke for 90-degree nominal rotation applications and designed for 60,000 full stroke cycles and normal operation between 0 and 130 F.

1. Actuators control shall be compatible with SPST control switch and with torque ratings of 30 lb-in.
2. Actuator timing shall be 25 seconds maximum in powered instances and shall spring-return in 15 seconds.
3. Actuators shall be UL listed with UL873 plenum rating with die-cast aluminum housing with integral junction box and conduit knockouts, and designed to operate reliably in smoke control systems requiring UL555S ratings up to 350F.
4. The actuator shall be designed to operate for 30 minutes during a one-time excursion to 350F.
5. Actuator shall require no special cycling during long-term holding, and shall "hold" with no audible noise at a power consumption of approximately half of the driving power.
6. Actuators shall be 24 volt (ML8115) or 120 volt (ML4115) with models for clockwise (add a B suffix) and counter-clockwise (add an A suffix) spring return.

W. Temperature Control Panels: Furnish temperature control panels of code gauge steel with locking doors for mounting all devices as shown. Control panels shall meet all requirements of Title 24, California Administrative Code. All electrical devices within a control panel shall be factory wired. All external wiring shall be connected to terminal strips mounted within the panel. Provide printed pvc nameplates identifying all devices mounted on the face of control panels. A complete set of 'as-built' control drawings (relating to the controls within that panel) shall be furnished within each control panel.

2.23 INSTALLATION

A. All work described in this section shall be performed by system integrators or contractors that have a successful history in the design and installation of integrated control systems. The installing office shall have a minimum of five years of integration experience and shall provide documentation in the submittal package verifying the company's experience.

B. Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.

C. Drawings of the TCS and FMCS network are diagrammatic only and any apparatus not shown, but required to make the system operative to the complete satisfaction of the Architect shall be furnished and installed without additional cost.

D. Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by this contractor in accordance with these specifications.

E. Equipment furnished by the HVAC Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by this contractor.

2.24 WIRING

A. All electrical control wiring and power wiring to the control panels, NAC, computers and network components shall be the responsibility of this contractor.

B. The electrical subcontractor (Div. 23) shall furnish all power wiring to electrical starters and motors.

C. All wiring shall be in accordance with the Project Electrical Specifications, the National Electrical Code and any applicable local codes. All FMCS wiring shall be installed in the conduit types specified in the Project Electrical Specifications unless otherwise allowed by the National Electrical Code or applicable local codes. Where FMCS plenum rated cable wiring is allowed it shall be run parallel to or at right angles to the structure, properly supported and installed in a neat and workmanlike manner.

2.25 WARRANTY

A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.

B. Within this period, upon notice by the Owner, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by this contractor at no expense to the Owner

2.26 WARRANTY ACCESS

A. The Owner shall grant to this contractor, reasonable access to the TCS and FMCS during the warranty period.

B. The owner shall allow the contractor to access the TCS and FMCS from a remote location for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period.

2.27 SOFTWARE LICENSE

A. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s).

B. The owner, or his appointed agent, shall receive ownership of all job specific software configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and /or configured for use within Niagara Framework (Niagara) based controllers and/or servers and any related LAN / WAN / Intranet and Internet connected routers and devices. Any and all required Ids and passwords for access to any component or software program shall be provided to the owner.

2.28 ACCEPTANCE TESTING

A. Upon completion of the installation, this contractor shall load all system software and start-up the system. This contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.

B. This contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.

C. Upon completion of the performance tests described above, repeat these tests, point by point as described in the validation log above in presence of Owner's Representative, as required. Properly schedule these tests so testing is complete at a time directed by the Owner's Representative. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.

D. System Acceptance: Satisfactory completion is when this contractor and the Division 16 contractor have performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

2.29 OPERATOR INSTRUCTION, TRAINING

A. During system commissioning and at such time acceptable performance of the TCS and FMCS hardware and software has been established this contractor shall provide on-site or remote operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.

B. This contractor shall provide 24 hours of instruction to the owner's designated personnel on the operation of the TCS and FMCS and describe its intended use with respect to the programmed functions specified. Operator orientation of the systems shall include, but not be limited to; the overall operation program, equipment functions (both individually and as part of the total

integrated system), commands, systems generation, advisories, and appropriate operator intervention required in responding to the System's operation.

C. The training shall be in three sessions as follows:
   1. Initial Training: One (8 hours) session after system is started up and at least one week before first acceptance test. Manual shall have been submitted at least two weeks prior to training so that the owners' personnel can start to familiarize themselves with the system before classroom instruction begins.
   2. First Follow-Up Training: One (8 hours) session approximately two weeks after initial training, and before Formal Acceptance. These sessions will deal with more advanced topics and answer questions.
   3. Warranty Follow Up: One (8 hours) session to be scheduled at the request of the owner during the one-year warranty period. These sessions shall cover topics as requested by the owner such as; how to add additional points, create and gather data for trends, graphic screen generation or modification of control routines.

2.30 STATUS SENSORS

A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.

B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, piped across pump.

C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

H. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that [**conditioned**]power supply is available to control units and operator workstation.

B. Verify that pneumatic piping and duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

3.2 INSTALLATION

A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.

B. Connect and configure equipment and software to achieve sequence of operation specified.

C. Mount compressor and tank unit on [**elastomeric mounts**] [**spring isolators with 1-inch static deflection**] [**restrained spring isolators with 1-inch static deflection**]. Vibration isolators are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment." Isolate air supply with wire-braid-reinforced rubber hose. Secure and anchor according to manufacturer's written instructions and seismic-control requirements.

1. Pipe manual and automatic drains to nearest floor drain.
2. Supply instrument air from compressor units through filter, pressure-reducing valve, and pressure relief valve, with pressure gages and shutoff and bypass valves.

D. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices [**48 inches**] [**60 inches**] **<Insert dimension>** above the floor.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

E. Install guards on thermostats in the following locations:

1. Entrances.
2. Public areas.
3. Where indicated.

F. Install automatic dampers according to Section 233300 "Air Duct Accessories."

G. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

H. Install labels and nameplates to identify control components according to Section 230553 "Identification for HVAC Piping and Equipment."

I. Install hydronic instrument wells, valves, and other accessories according to Section 232113 "Hydronic Piping."

J. Install steam and condensate instrument wells, valves, and other accessories according to Section 232213 "Steam and Condensate Heating Piping."

K. Install refrigerant instrument wells, valves, and other accessories according to Section 232300 "Refrigerant Piping."

L. Install duct volume-control dampers according to Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts."

M. Install electronic and fiber-optic cables according to Section 271500 "Communications Horizontal Cabling."

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Section 260533 "Raceways and Boxes for Electrical Systems."

B. Install building wire and cable according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Install signal and communication cable according to Section 271500 "Communications Horizontal Cabling."

1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
2. Install exposed cable in raceway.
3. Install concealed cable in raceway.
4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect[**, test, and adjust**] field-assembled components and equipment installation, including connections[**, and to assist in field testing**]. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
4. Pressure test control air piping at 30 psig or 1.5 times the operating pressure for 24 hours, with maximum 5-psig loss.
5. Pressure test high-pressure control air piping at 150 psig and low-pressure control air piping at 30 psig for 2 hours, with maximum 1-psig loss.
6. Test calibration of [**pneumatic**] [**electronic**] controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
7. Test each point through its full operating range to verify that safety and operating control set points are as required.
8. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
9. Test each system for compliance with sequence of operation.
10. Test software and hardware interlocks.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check instrument tubing for proper fittings, slope, material, and support.
5. Check installation of air supply for each instrument.
6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
8. Check temperature instruments and material and length of sensing elements.
9. Check control valves. Verify that they are in correct direction.
10. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
11. Check DDC system as follows:

    a. Verify that DDC controller power supply is from emergency power supply, if applicable.
    b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    c. Verify that spare I/O capacity has been provided.
    d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:

    a. Check analog inputs at 0, 50, and 100 percent of span.
    b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
    c. Check digital inputs using jumper wire.
    d. Check digital outputs using ohmmeter to test for contact making or breaking.
    e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

5. Flow:

    a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
    b. Manually operate flow switches to verify that they make or break contact.

6. Pressure:

    a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
    b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

7. Temperature:

    a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
    b. Calibrate temperature switches to make or break contacts.

8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to

[**three**] **<Insert number>** visits to Project during other than normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Section 017900 "Demonstration and Training."

3.7 AS-BUILTS

A. Upon completion of the work, provide a complete set of 'as-built' drawings and application software (Web-Supervisor only, if applicable) on compact disk. Drawings shall be provided as pdf files. Division 23 and 26 contractors shall provide as-builts for their portions of work. The Division 23 contractor shall be responsible for as-builts pertaining to overall TCS and FMCS architecture and network diagrams.

END OF SECTION 230900

SECTION 237423.16 - PACKAGED, INDIRECT-FIRED, OUTDOOR, HEATING-ONLY MAKEUP-AIR UNITS - REPAIR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes the replacement of components of an existing McQuay indirect-fired makeup-air unit located on the gym roof and serves the locker rooms. The existing unit is a double wall modular type unit.

1.3 DEFINITIONS

A. DDC: Direct digital control.

B. ETR: Existing to Remain

1.4 ACTION SUBMITTALS

A. Product Data: For each type and configuration of outdoor, indirect-fired makeup-air unit.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each type and configuration of outdoor, indirect-fired heating and ventilating unit.
1. Include details of equipment assemblies.
2. Detail fabrication and assembly of gas-fired heating and ventilating units, as well as procedures and diagrams.
3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Startup service reports.

B. Sample Warranty: For manufacturer's special warranty.

1.6 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of indirect-fired heating and ventilating units that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Daikin/McQuay – Existing unit is a RAH077CSA, 15,000 cfm, 100% outside air unit.

2.2 SYSTEM DESCRIPTION

A. Replacement of the following components:
1. Burner Module.
2. Burner Module External Panels
3. Burner Hood
4. Burner Controls

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 UNIT CASINGS

A. General Fabrication Requirements for Casings:

1. Forming: Form walls, roofs, and floors with at least two breaks at each joint.
2. Casing Joints: Sheet metal screws or pop rivets, factory sealed with water-resistant sealant.
3. Factory Finish for Galvanized-Steel Casings: Apply manufacturer's standard primer immediately after cleaning and pretreating.

4. Factory Finish for Steel and Galvanized-Steel Casings: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on enamel finish, consisting of prime coat and thermosetting topcoat.
5. Casing Coating: Epoxy.
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

B. Cabinet: Galvanized-steel panels, formed to ensure rigidity and supported by galvanized-steel channels or structural channel supports with lifting lugs. Duct flanges at inlet and outlet. Pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.

C. Outer Casing: 0.0598-inch- thick steel with heat-resistant, baked-enamel finish.

D. Inner Casing:

1. Burner Section Inner Casing: 0.0299-inch-thick steel.
2. Double-wall casing with inner wall of solid steel.
3. Internal Insulation: Fibrous-glass duct lining, neoprene coated, comply with ASTM C 1071, Type II, applied on burner and fan sections only.
   a. Thickness: 1 inch.
   b. Insulation Adhesive: Comply with ASTM C 916, Type I.
   c. Density: 1.5 lb/cu. ft..
   d. Mechanical Fasteners: Galvanized steel suitable for adhesive, mechanical, or welding attachment to casing without damaging liner when applied as recommended by manufacturer and without causing air leakage.

E. Casing Insulation and Adhesive:

1. Materials: ASTM C 1071, Type I.
2. Location and Application: Factory applied with adhesive and mechanical fasteners to the internal surface of section panels downstream from, and including, the heating-coil section.
   a. Liner Adhesive: Comply with ASTM C 916, Type I.
   b. Mechanical Fasteners: Galvanized steel, suitable for adhesive, mechanical, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
   c. Liner materials applied in this location shall have airstream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric, depending on service-air velocity.
3. Location and Application: Encased between outside and inside casing.

2.4 ACCESSORIES

A. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

2.5 OUTDOOR-AIR INTAKE HOOD

A. Existing to remain.

2.6 ROOF CURBS

A. The existing roof curb shall remain.

2.7 SUPPLY-AIR FAN

A. The existing fan shall remain. Clean fan and replace belts if required.

2.8 AIR FILTERS

1. Provide new filters, to be installed in the existing filter rack.

2.9 DAMPERS

A. Outdoor-AirDamper: Existing to remain. Clean damper, check and replace seals if required.

B. Damper Operator: Verify operation. Provide pricing to replace if required.

2.10 INDIRECT-FIRED GAS BURNER

A. Description: Factory assembled, piped, and wired; and complying with ANSI Z21.47, "Gas-Fired Central Furnaces," and with NFPA 54, "National Fuel Gas Code."

1. CSA Approval: Designed and certified by and bearing label of CSA.
2. Burners: Stainless steel.

a. Gas Control Valve: Modulating.
b. Fuel: Natural gas.
c. Minimum Combustion Efficiency: 80 percent.
d. Ignition: Electronically controlled electric spark with flame sensor.

B. Venting: Power vented, with integral, motorized centrifugal fan interlocked with gas valve.

C. Heat Exchanger: Stainless steel.

D. Heat-Exchanger Drain Pan: Stainless steel.

E. Safety Controls:

1. Vent Flow Verification: Differential pressure switch to verify open vent.
2. Control Transformer: 24-V ac.
3. High Limit: Thermal switch or fuse to stop burner.
4. Gas Train: Regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, electronic-modulating temperature control valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.
5. Purge-period timer shall automatically delay burner ignition and bypass low-limit control.
6. Gas Manifold: Safety switches and controls complying with ANSI standards and FM Global.
7. Airflow Proving Switch: Differential pressure switch senses correct airflow before energizing pilot.
8. Automatic-Reset, High-Limit Control Device: Stops burner and closes main gas valve if high-limit temperature is exceeded.
9. Safety Lockout Switch: Locks out ignition sequence if burner fails to light after three tries. Controls are reset manually by turning the unit off and on.

2.11 UNIT CONTROL PANEL

A. Factory-wired, fuse-protected control transformer, connection for power supply and field-wired unit to remote control panel.

B. Control Panel: Surface-mounted remote panel, with engraved plastic cover and the following lights and switches:

1. On-off-auto fan switch.
2. Heat-vent-off switch.
3. Supply-fan operation indicating light.
4. Heating operation indicating light.
5. Thermostat.
6. Damper position potentiometer.
7. Dirty-filter indicating light operated by unit-mounted differential pressure switch.
8. Safety-lockout indicating light.
9. Enclosure: NEMA 250, Type 1.

2.12 CONTROLS

A. Comply with requirements in Section 230923 "Direct Digital Control (DDC) System for HVAC"

B. Control Devices:

1. Remote Thermostat: Adjustable duct mounted (return/exhaust) thermostat.
2. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
3. Duct Mounted Smoke detectors (existing)

C. Fan Control: Interlock fan to start with exhaust fan(s) to which this heating and ventilating unit is associated for makeup air. (EF-16 and EF-16A)

D. Fan Control: Timer starts and stops indirect-fired heating and ventilating unit and exhaust fan(s).

1. Smoke detectors, located in supply air, shall stop fans when the presence of smoke is detected.

E. Outdoor-Air Damper Control, 100 Percent Outdoor-Air Units: Outdoor-air damper shall open when supply fan starts, and close when fan stops.

F. Temperature Control: Operates gas valve to maintain supply-air temperature.

1. Operates gas valve to maintain discharge-air temperature with factory-mounted sensor in blower outlet.
2. Operates gas valve to maintain space temperature with wall-mounting, field-wired sensor with temperature adjustment, and adjustment on remote-control panel.
3. Timer shall select remote setback thermostat to maintain space temperature at 60 deg F.
4. Burner Control: Twenty steps of control using one burner sections in series.

G. Interface with DDC System for HVAC: Factory-installed hardware and software to enable the DDC system for HVAC to monitor, control, and display status and alarms of heating and ventilating unit.

1. Hardwired Points:

a. Return Air temperature.
b. Discharge-air temperature.
c. Burner operating.

2. ASHRAE 135.1 (BACnet) communication interface with the DDC system for HVAC shall enable the DDC system for HVAC operator to remotely control and monitor the heating and ventilating unit from an operator workstation. Control features and monitoring points displayed locally at heating and ventilating unit control panel shall be available through the DDC system for HVAC.

2.13 MOTORS

1. Existing to remain motors.

2.14 CAPACITIES AND CHARACTERISTICS

A. Fan:

1. Discharge Configuration: Vertical.
2. Airflow in CFM: 15,000.
3. External Static Pressure: 2.0.
4. Maximum RPM: 1059.

B. Fan Motor:

1. Horsepower: 20.

C. Single-Point Electrical Connection:

1. Volts: 480.
2. Phase: Three.
3. Hertz: 60.
4. Maximum Overcurrent Protection: 70A.

D. Indirect-Fired Gas Burner:

1. Minimum Combustion Efficiency: 80 percent.
2. Entering-Air Temperature: 0.
3. Leaving-Air Temperature: 90.
4. Airflow: 15,000.
5. Gas Input: 1,875,000 btu.
6. Burner Output: 1,500,000 btu.
7. Turndown Ratio: 20:1.
8. Minimum Inlet Pressure: .5 In wc.
9. Maximum Inlet Pressure: 5 In wc.
10. Gas Piping Connection Size: 1.5.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.

C. Verify cleanliness of airflow path to include inner-casing surfaces, filters, coils, turning vanes, fan wheels, and other components.

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

3.2 INSTALLATION

A. Install controls and equipment shipped by manufacturer for field installation with indirect-fired heating and ventilating units.

3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

1. Gas Piping: Connect gas piping with shutoff valve and union, and with sufficient clearance for burner removal and service. Make final connections of gas piping to unit with corrugated, stainless-steel tubing flexible connectors complying with ANSI LC 1/CSA 6.26 equipment connections.

B. Duct Connections: Connect supply ducts to indirect-fired heating and ventilating units with flexible duct connectors. Comply with requirements in Section 233300 "Air Duct Accessories" for flexible duct connectors.

C. Ground equipment utilizing the existing grounding setup.

D. Reuse the existing power feed and disconnect to the unit.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections with the assistance of a factory-authorized service representative.

C. Units will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

1. Inspect for visible damage to burner combustion chamber.
2. Inspect casing insulation for integrity, moisture content, and adhesion.
3. Verify that clearances have been provided for servicing.
4. Verify that controls are connected and operable.
5. Verify that filters are installed.
6. Purge gas line.
7. Inspect and adjust vibration isolators.
8. Verify bearing lubrication.
9. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
10. Adjust fan belts to proper alignment and tension.

C. Start unit according to manufacturer's written instructions.

1. Complete startup sheets and attach copy with Contractor's startup report.
2. Inspect and record performance of interlocks and protective devices; verify sequences.
3. Operate unit for run-in period recommended by manufacturer.

4. Perform the following operations for both minimum and maximum firing, and adjust burner for peak efficiency:

   a. Measure gas pressure at manifold.
   b. Measure combustion-air temperature at inlet to combustion chamber.
   c. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.

5. Calibrate thermostats.
6. Adjust and inspect high-temperature limits.
7. Inspect dampers, if any, for proper stroke and interlock with return-air dampers.
8. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
9. Measure and record airflow. Plot fan volumes on fan curve.
10. Verify operation of remote panel, including pilot-operation and failure modes. Inspect the following:

    a. High-limit heat.
    b. Alarms.

11. After startup and performance testing, change filters, verify bearing lubrication, and adjust belt tension.
12. Verify drain-pan performance.
13. Verify outdoor-air damper operation.

3.6 ADJUSTING

A. Adjust initial temperature set points.

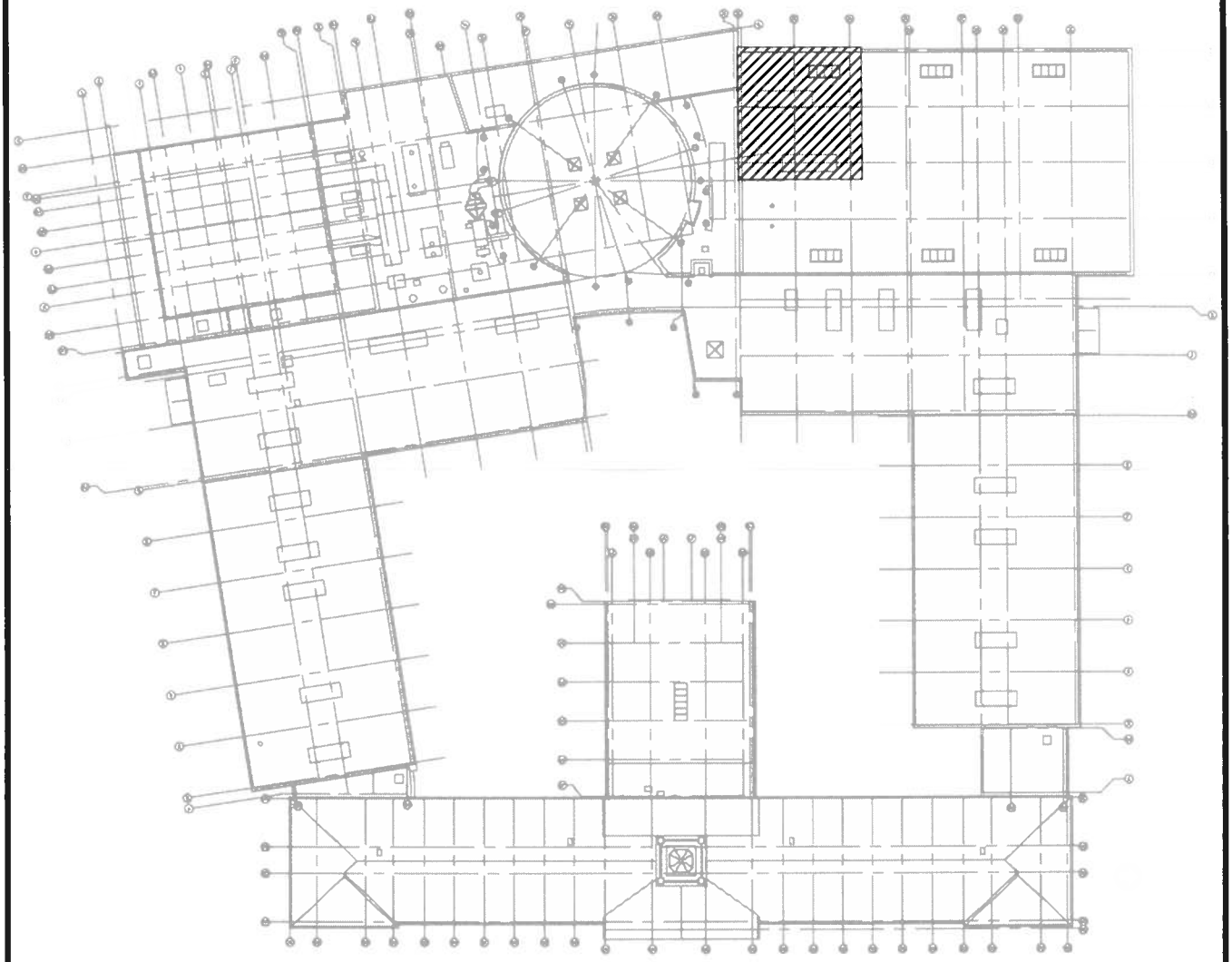
B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain heating and ventilating units.

END OF SECTION 237423.16



1 OVERALL ROOF KEY PLAN

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CONTROL UPGRADE
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HAMDEN, CT

Drawn By:	H.F.	Origin:	XXX XXX
Checked By:	J.K.	DWG. Ref:	X/AX.XX
Project No.	16D3041	Scale:	AS NOTED
CAD File:	MSK-1	Date:	05/27/2016
Title:			MSK-1

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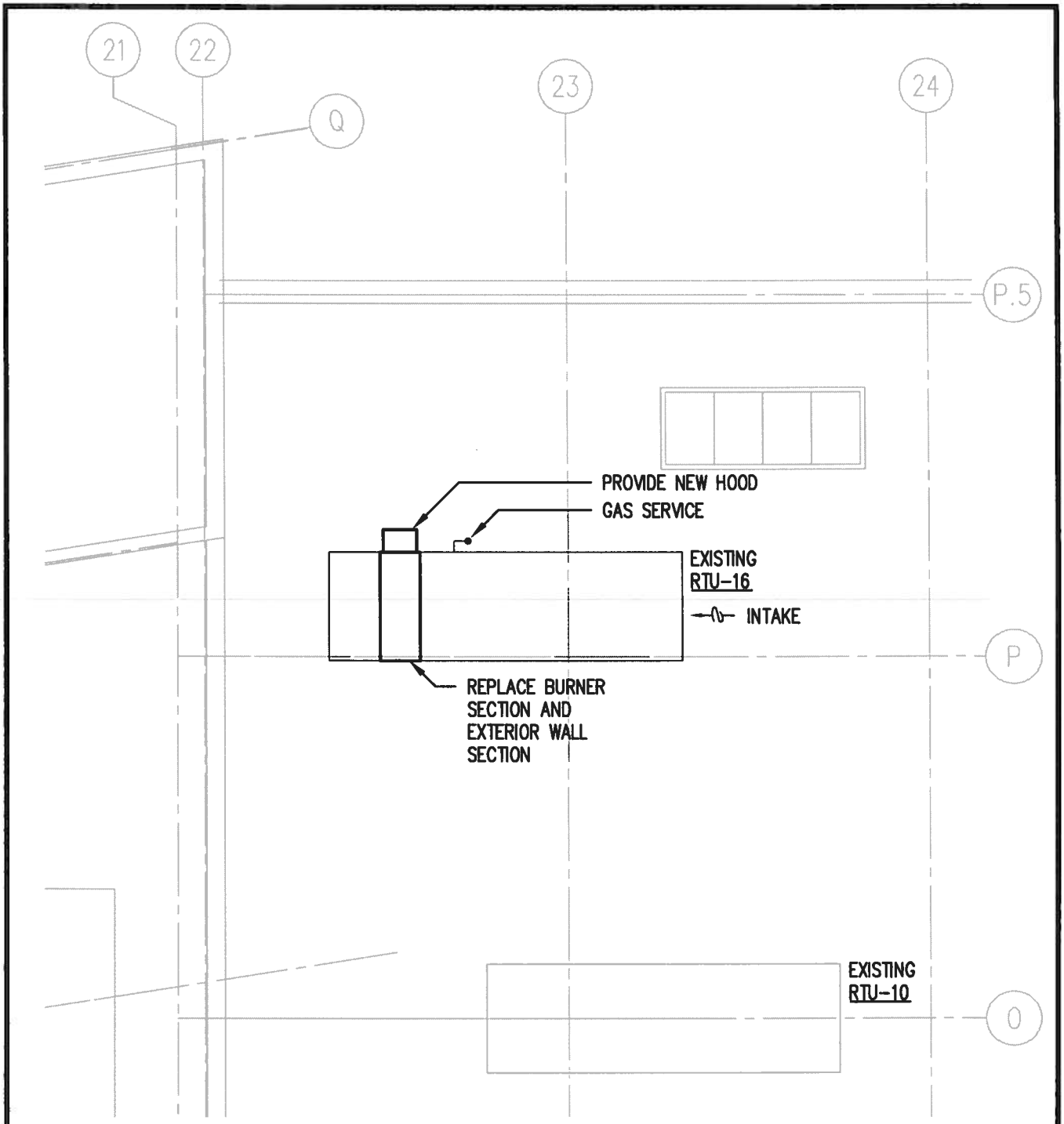

1 PARTIAL ROOF PLAN

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Drawn By:	H.F.	Origin:	XXX XXX
Checked By:	J.K.	DWG. Ref:	X/AX.XX
Project No.	16D3041	Scale:	AS NOTED
CAD File:	MSK-2	Date:	05/27/2016
Title:			MSK-2

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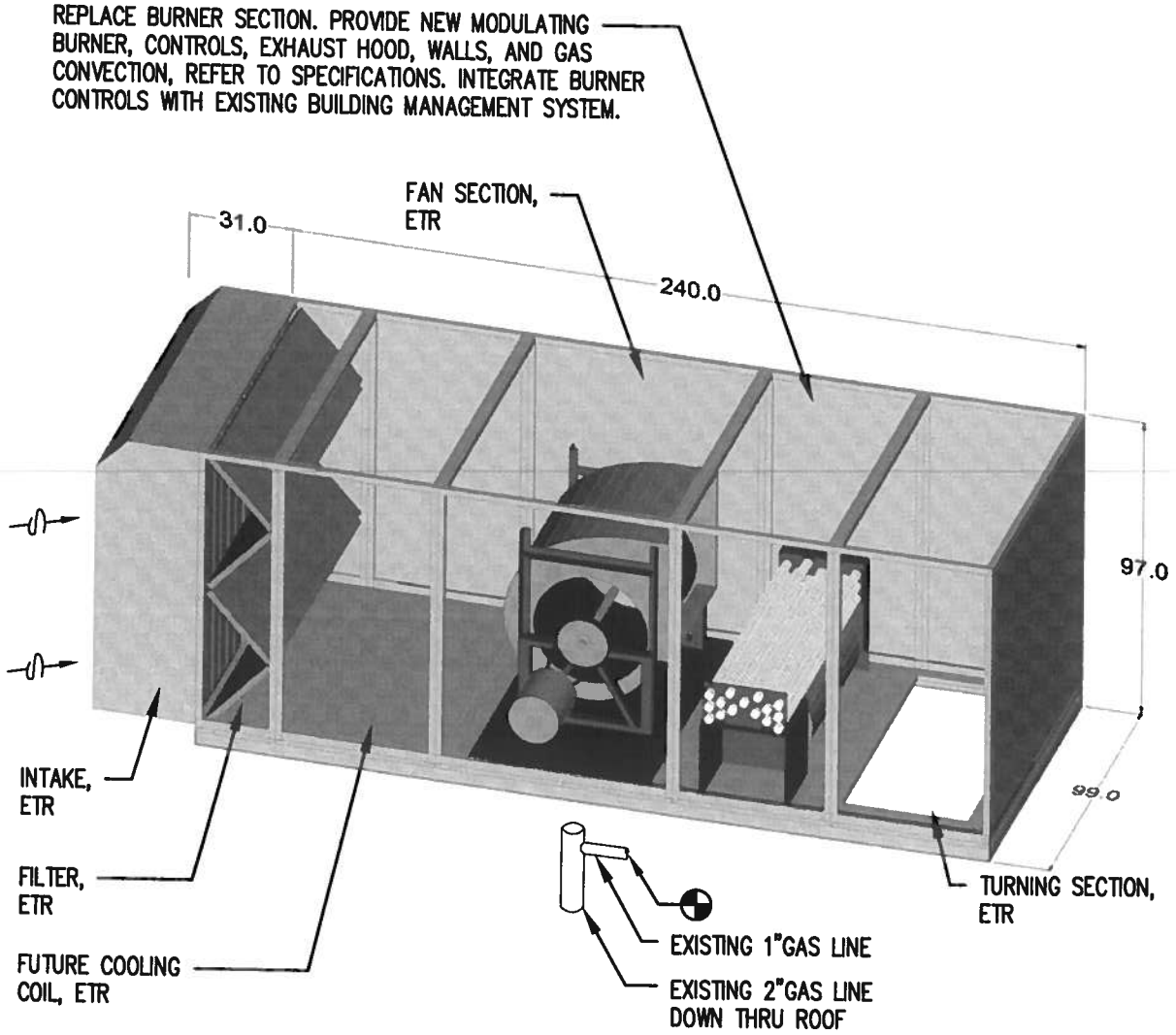

1 RTU-16 DETAIL

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BL Companies

ARCHITECTURE
ENGINEERING
ENVIRONMENTAL
LAND SURVEYING

355 Research Parkway
Meriden, CT 06450
(203) 630-1406
(203) 630-2815 Fax

HAMDEN HIGH SCHOOL
CONTROL UPGRADE
2050 DIXWELL AVE.
HAMDEN, CT

Drawn By:	H.F.	Origin:	XXX /XXX
Checked By:	J.K.	DWG. Ref:	X/AX.XX
Project No.	16D3041	Scale:	AS NOTED
CAD File:	MSK-3	Date:	05/27/2016
Title:			

MSK-3

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TOWN OF HAMDEN

GENERAL BID SPECIFICATIONS -- PART A

Bids shall be made on the bid forms furnished by the Town, without alteration. Bids shall be submitted in a sealed envelope, stating on the outside of the envelope the words "BID DOCUMENTS", the Town's bid number, the title of the Project, the title of the bid package for which a bid is being submitted, and the time and date of the bid opening. All bidders shall provide two copies of their bid, unless otherwise stated.

Bids received after the bid opening deadline shall be rejected. All spaces on the bid form must be filled in with figures and words or the Town, in its sole discretion, may reject the bid as non-responsive. No faxed or emailed bids are allowed.

BID SECURITY: Each bid shall be accompanied by a certified check or bid bond for five percent (5%) of the total bid. The Bid Security will be returned by the Town upon signing of the contract with the successful bidder. Checks or bonds must be made to the order and for the benefit of the "Town of Hamden". Security may be held by the Town of Hamden for a period not to exceed 90 days from the date of the opening of the bids for the purpose of reviewing the bids. Bids shall not be combined, unless otherwise permitted in the Invitation to Bid or Instructions to Bidders. A separate bid surety shall be presented for each bid.

LIQUIDATED DAMAGES: The successful bidder, upon his/her/its failure or refusal to sign the contract within five (5) business days of receipt of the contract from the Town, shall forfeit to the Town as liquidated damages for such failure or refusal an amount equal to the security deposited with his/her bid.

The Town may make such investigations and conduct such scope reviews as deemed necessary by the Town in order for the Town to determine the ability of the bidder to perform the work and the bidder shall promptly, upon the Town's request, furnish to the Town all such data for this purpose. The Town expressly reserves the right to reject a bid if, in the Town's sole discretion, the Town determines that a bid is non-responsive, a bidder is not responsible, a bidder is not qualified to perform the work or the Town otherwise determines that the award of a contract to the bidder is not in the best interest of the Town. Conditional bids will not be accepted.

SUBCONTRACTORS: The bidder is specifically advised that any person, firm or other party to whom bidder intends to award a subcontract or purchase order must be acceptable to the Town and that approval of the proposed subcontract award cannot be sought from the Town unless and until the successful bidder submits all information and evidence to the Town regarding the qualifications, experience and responsibility of the proposed subcontractor. Although the bidder is not required to attach such information to its bid, the bidder is hereby advised of this requirement so that it may plan accordingly and prevent delays.

MODIFICATION: Any bidder may modify his/her/its bid **prior** to the scheduled deadline for receipt of bids. See paragraph one above. The bidder wishing to modify its bid shall submit such modified bid in accordance with paragraph one above, shall unequivocally indicate that its prior bid is superseded by the modified bid and shall submit its modified bid in an envelope clearly marked "**MODIFIED BID**".

ERRORS: The Town, in its sole discretion, reserves the right to waive typographical or technical defects in the bid, as well as its right to correct an award erroneously made as a result of a clerical error on the part of the Town of Hamden.

PERMITS/LICENSES: All applicable permits and licenses shall be obtained at the sole cost of bidders. No permits or permit fees shall be waived by the Town unless otherwise stated in the Town's Invitation to Bid or Instructions to Bidders.

OBLIGATIONS OF BIDDER: Each bidder shall, prior to submitting a bid, familiarize itself with the conditions under which the work will be performed and conduct its own due diligence. Bidders shall be presumed to have read and to be thoroughly familiar with the specifications and all bid documents. The failure of any bidder to request, receive or examine any information or the failure of the bidder to familiarize itself with the conditions relating to the performance and timing of the work shall in no way relieve any bidder from any obligation in respect to the bid and shall not subject the Town to any liability whatsoever.

Furthermore, the bidder is responsible for being aware of and conforming in all respects to all existing Federal, State of Connecticut, and Town of Hamden Statutes, Ordinances, Regulations, laws and other legal applicable legal requirements, regardless of whether any such applicable requirements are specifically identified in the bid documents.

WITHDRAWAL OF BIDS: Bids may be withdrawn prior to the time fixed for opening by submitting written notification of withdrawal to the Town prior to the bid opening deadline.

Negligence or mistake on the part of the bidder in preparing the bid confers no right of withdrawal or modification of the bid after such bid has been opened.

"OR EQUAL" CLAUSE: Whenever a material, article or piece of equipment is identified in the bid document by reference to manufacturers' or vendors' names, trade names, catalog numbers, etc., it is intended to establish a standard, unless otherwise stated; any material, article, or equipment of other manufacturers and vendors which will perform adequately the duties imposed by the general design may be considered equally acceptable if, in the opinion of the Town, the material, article, or equipment so proposed is of equal substance and function. Any substitutions must be approved in writing by the Purchasing Agent or his designee, who shall have sole discretion to determine the acceptability of the proposed substitute.

PATENTS: The contractor shall indemnify, defend and hold harmless the Town and its officers, agents, and employees from and against liability and costs of any nature or kind, including cost and expenses for, or on account of, any patented or unpatented invention, process, article, or appliance manufactured or used in the performance of the contract, including its use by the Town unless otherwise specifically stipulated in the contract or bid documents.

NON-COLLUSIVE BID STATEMENT: All bidders shall be required to sign the non-collusive statement attached.

FUNDING: The municipal non-appropriation clause may be applicable.

Applicable if checked

☒ **PERFORMANCE AND** ☒ **PAYMENT BONDS**: To ensure the delivery of goods and services in conformity with the specifications provided and payment of all subcontractors and suppliers, bidders shall provide payment and performance bonds for any project (1) which is governed by Connecticut's Little Miller Act, C.G.S. §49-41 or (2) for which the Town requires the provision of payment and performance bonds. Successful bidders shall provide the Town with payment and performance bonds, at the bidder's expense, each for the full amount of the contract awarded. The Town shall be the Obligee under each bond and the bonds shall be issued by a company authorized to conduct surety business in the State, listed on the U.S. Department of the Treasury's List of Approved Sureties and subject to approval by the Town.

☒ **INSURANCE:** The contractor will provide adequate proof of insurance to the Town for the types of insurance and limits indicated below, providing for all of its operations performed in compliance with this contract.

The successful bidder shall obtain and pay for the insurance coverage described below with the indicated minimum limits. Bidders agree to furnish Certificates of Insurance to the Town and/or its Board of Education, certifying coverage to be in effect for the term of this contract and that the Town and/or Board of Education will be given sixty (60) days prior written notice of cancellation or non-renewal.

These requirements if checked also apply to any subcontractor or common carrier used by the Bidder.

☒ I. WORKERS COMPENSATION

Connecticut	Statutory Limits
Applicable Federal	Statutory Limits
Employer's Liability	$100,000 per Accident
	$100,000 Disease per Employee
	$500,000 Policy Limit

See Section1.20

☒ II. COMMERCIAL GENERAL LIABILITY

Each Occurrence	$1,000,000
Damage to Rented Premises	$ 50,000
Medical Expense	$ 5,000
Personal Injury/Advertising	$ 1,000,000
General Aggregate	$ 3,000,000
Products & Completed Operations Aggregate	$ 1,000,000

Coverage to include Premise-Operations, Contractors Protective Liability, Products & Completed Operations, Explosion, Collapse & Underground, Contractual Liability, & Broad Form Property Damage.

☒ III. BUSINESS AUTOMOBILE LIABILITY (including owned, hired & non-owned vehicles)

Liability (Combined Single Limit) $1,000,000

(If hazardous material or potential pollutants are transported, MCS90 – Accidental Pollution coverage is required)

☒ IV. UMBRELLA/EXCESS LIABILITY (If Required)

Liability Limit – Each Occurrence over primary	$3,000,000
Self-Insured retention	$10,000

☐ V. POLLUTION LIABILITY (If Required)

Bodily Injury and Property Damage	$1,000,000 Each Occurrence
	$1,000,000 Aggregate

☐ VI. PROFESSIONAL LIABILITY (If Required)

$3,000,000 Each Occurrence
$3,000,000 Aggregate

VII. The Town of Hamden and/or Hamden Board of Education to be named as an additional insured on all insurance policies, except Workers Compensation.

VIII. The bidder shall indemnify, defend and hold the Town of Hamden and/or Hamden Board of Education harmless for and against any and all injuries to persons and/or property resulting out of performance of this contract and resulting from the bidder's negligence.

ITEM VII AND VIII MUST APPEAR ON THE FACE OF THE INSURANCE CERTIFICATE IN THE SECTION ENTITLED "DESCRIPTION OF OPERATION

Occupational Safety and Health Administration Requirements; Safety Compliance: According to Connecticut General Statutes, Section 31-53b (a) each contract entered into on or after July 1, 2007 , for the construction, remodeling, refinishing, refurbishing, rehabilitation, alteration or repair of any public building project by the state or any of its agents, or by a political subdivision of the state or any of its agents, where the total cost of all work to be performed by all contractors and subcontractors in connection with the contract is at least one hundred thousand dollars ($100,000.00) shall contain a provision requiring that, not later than thirty days after the date such contract is awarded, each contractor furnish proof to the Labor Commissioner that all employees performing manual labor on or in such public building , pursuant to such contract, have completed a course of at least ten hours in duration in construction safety and health approved by the federal Occupational Safety and Health Administration or, in the case of telecommunications employees, have completed at least ten hours of training in accordance with 29 CFR 1910.268. The contractor shall familiarize itself with all aspects of state law and any applicable regulations pertaining to these requirements in order to ensure full compliance. Moreover, contractor shall be solely responsible for full and timely compliance with all federal, state and local safety standards, rules and regulations.

INDEMNITY/HOLD HARMLESS: The contractor's insurance policies will be endorsed to provide for the Town of Hamden to be named as an additional insured. The contractor will indemnify and save harmless the Town of Hamden from all suits and actions related to injuries to and/or damage to the property of others as a result of the activities of the contractor, its servants and agencies acting for the contractor.

CERTIFICATE OF INSURANCE: The contractor, prior to the start of any work under this contract, shall provide the Town's Purchasing Office with a certificate of insurance to conform to the following:

a. Form(s) acceptable to the Town of Hamden.
b. Insurance provided by insurance companies authorized to write coverage in the State of Connecticut.
c. Policy dates must cover the term of this contract.
d. Certificate will provide for at least 30 days' notice to the Town of Hamden prior to cancellation.
e. All additional insured certificates are to list the Town of Hamden.

Under no circumstances shall the contractor begin work until (1) the contract for same shall have been signed by all parties, (2) the required bonds have been furnished by contractor and approved by the Town, (3) the required certificates of insurance have been filed with and approved by the Town's Purchasing Office and (4) the Contractor has been duly instructed in writing by the Town to proceed with the work. If the contractor commences the work before the provisions referred to in this paragraph are fulfilled, the Town, in its sole option, may cancel or terminate the contract without penalty or liability chargeable to the Town.

LICENSURE: At the time of the bid submissions, bidders shall possess the necessary license(s) to perform the work that is the subject of this invitation to bid.

NON-RESIDENT CONTRACTORS: Out of state contractors must post a bond with the Connecticut Department of Revenue Services. The non-resident contractor must receive a Connecticut tax registration number by completing and submitting form REG-1. Non-resident contractors are directed to familiarize themselves and achieve full compliance with applicable requirements, including Form AU-766.

Non-Discrimination and Affirmative Action: The successful bidder, in performing under this contract, shall not discriminate against any worker, employee or applicant, or any member of the public, because of race, creed, color, age, marital status, sexual orientation, national origin, ancestry, sex, mental retardation or physical disability, including but not limited to blindness, unless it is shown by the contractor that such disability prevents performance of the work involved in any manner prohibited by the laws of the United States or the State of Connecticut, nor otherwise commit an unfair employment practice. The successful bidder further agrees that this article, (and any additional provisions required by law), will be incorporated by such contractor in all contracts entered into in connection with this contract. The following principles and requirements of Equal Opportunity and Affirmative Action, as incorporated herein, will be incorporated into "Equal Opportunity - Non-Discrimination Clause" to be included in all bid documents, purchase orders, leases and contracts. The principles of Affirmative Action are addressed in the 13th, 14th and 15th Amendments of the United States Constitution, Civil Rights Act of 1964, Equal Pay Act of 1963, Title VI and VII of the 1964 United States Civil Rights Act, Presidential Executive Orders 11246, 11375, 11478 (nondiscrimination under federal contracts), Act 1, Section 1 and 20 of the Connecticut Constitution, Governor Grasso's Executive Order Number 11, Governor O'Neill's Executive Order Number 9, the Connecticut Fair Employment Practices Law (Sec. 46a-60-69) of the Connecticut General Statutes, Connecticut Code of Fair Practices (46a-70-81), Deprivation of Civil Rights (46a-58 (a)(d)), Public Accommodations Law (46a-63-64), Discrimination against Criminal Offenders (46a-80), definition of blind (46a-51(1)), definition of Physically Disabled (46a-51 (15)), definition of Mentally Retarded (46a-51-13), cooperation with the Commission on Human Rights and Opportunities (46a-77), Sexual Harassment (46a-60 (a)-8), Connecticut Credit Discrimination Law (360436 through 439), Title 1 of the State and the Local Fiscal Assistance Act 1 1972. Every contract to which the State is party must contain the nondiscrimination and affirmative action provisions provided in the Connecticut General Statutes Section 4a-60a. The successful bidder also agrees to comply with all provisions of the Town's Charter and Code of Ordinances –"Town of Hamden, Chapter 110, Business Transactions with Town". The contractor shall cooperate fully with the Connecticut Commission on Human Rights and Opportunities ("the Commission") and shall submit periodic reports of employment and subcontracting practices to the Commission in such a form, in such a manner, and at such time as may be prescribed by the Commission.

Set Asides: If this Project is funded in whole or in part by State of Connecticut funds, Public Act 15-5 (§§58-71 and 88) requires that, effective with all contracts executed after October 1, 2015, all solicitations

for municipal public works contracts funded in whole or in part with State funds state in the notice of solicitation that the contract must comply with the set asides mandated by Public Act 15-5. The set aside requirements include a requirement that 25% of the total value of contracts in excess of $50,000.00 be set aside for exclusive bidding for "small contractors," as defined by Section 58 (a) (1), and 25% of such amount (that is, 6.25% of the total value), be set aside for "minority business enterprises," as defined by Section 58(a) (4). For contracts in excess of $50,000.00, bidders must have obtained Commission approval of their Affirmative Action Plan prior to contract execution. BIDDERS ARE EXPRESSLY DIRECTED TO REVIEW PUBLIC ACT 15-5, SECTIONS 58-71 AND 88, TO FAMILIARIZE THEMSELVES WITH THE REQUIREMENTS OF SUCH LAWS. BIDDERS SHALL BE DIRECTLY AND SOLELY RESPONSIBLE FOR COMPLIANCE WITH THE REQUIREMENTS OF P.A. 15-5, SECTIONS 58 THROUGH 71 AND 88. THE TOWN ALSO DIRECT BIDDERS' ATTENTION TO THE SECTIONS 63 AND 64 (NON-DISCRIMINATION REQUIREMENTS) AND 66-68 (AFFIRMATIVE ACTION REQUIREMENTS).

Regardless of whether P.A. 15-5 is applicable to this Project, the contractor shall provide reasonable technical assistance and training to minority business enterprises to whom work is subcontracted to promote the participation of such concerns, to make a good faith effort to award a reasonable proportion of all subcontractors to such enterprises, and undertake such other reasonable activities or efforts as the Commission may prescribe to ensure the participation of minority business enterprises as contractors and subcontractors. The contractor shall include a provision in all subcontracts with minority business enterprises requiring the minority business enterprise to provide the Commission with such information on its structure and operations as the Commission finds necessary to make an informed determination as to whether the minority business enterprise is owned and operated by members of a minority group.

The contractor shall maintain full and accurate data, such as contract monitoring reports, for a period of three (3) years from the date of substantial completion of the project or for such longer period as is required by the law then in effect with regard to records retention. The contractor shall not discharge, discipline, or otherwise discriminate against any person who has filed a complaint, testified, or assisted in any proceeding with the Commission.

The contractor shall make available for inspection and copying any supporting data requested by the Commission and make available for interview any agent, servant, or employee having knowledge of any matter concerning the investigation of a discriminatory practice complaint of any matter relating to a contract compliance review.

CLAYTON ACT: The contractor or subcontractor offers and agrees to assign to the public purchasing body all right, title and interest in and to all causes of action it may have under Section 4 of the Clayton Act, 15 U.S.C. 15 or under Chapter 624 of the General Statutes of Connecticut arising out of the purchase of services, property or intangibles of any kind pursuant to a public purchase contract or subcontract. This assignment shall be made and become effective at the time the public purchasing body awards or accepts such contract, without further acknowledgment by the parties.

AWARD TO OTHER THAN THE APPARENT LOW BIDDER: The Town of Hamden reserves the right to award the work to a bidder other than the one which submitted the lowest price if it deems such action to be in the best interest of the Town of Hamden.

WAGE RATES: Workers employed in the various occupations on this named project shall be required to receive the minimum rates established by the State of Connecticut Labor Department Division of Regulations of Wages.

PRICES: Prices quoted for merchandise, supplies, or equipment shall be the net prices delivered into the Town of Hamden.

Town of Hamden reserves the right to award separate items to separate bidders. Bidders may indicate exceptions to this.

Bidders must include Federal ID number or Social Security number to be considered for bid approval.

DAVIS-BACON ACT - PREVAILING RATES OF WAGES
If this Project is subject to the Connecticut Prevailing Wage law, C.G.S. §31-53 *et seq.*, the Town of Hamden shall require the contractor to make payment of prevailing rates of wages in accordance with the wage section of the Davis-Bacon Act, Town of Hamden, Hamden Code, S 97.35 and State Statute 31-53, Part III. State Contracts, and shall institute such investigations and periodic monitoring procedures as deemed necessary to determine compliance with labor standard provisions and the Federal requirements of the Act as amended.

AS PER THE TOWN OF HAMDEN AFFIRMATIVE ACTION RESOLUTION:
It is in the best interest of the Town to encourage minority and/or female business enterprise. Where two substantially similar Hamden bids are submitted, preference may be given to the minority and/or female contractor.

RESERVED RIGHTS OF TOWN:
The Town of Hamden reserves the right to accept or reject any or all bids or proposals; to waive any technicality in a bid or proposal or part thereof submitted, and to accept the bid deemed to be in the best interest of the Town of Hamden. Further, the Town reserves the right to split bids and quotations among two or more bidders. The Town reserves the right to reject any bid submitted by a joint venture if the Town determines that any entity to the joint venture fails to satisfy the Town's requirements (i.e., bonding, insurance, qualifications, responsibility).

PREQUALIFICATION REQUIREMENT: The Connecticut Department of Administrative Services' Contractor Prequalification Program (C.G.S §4a-100) requires all contractors to prequalify before they can bid on a contract or perform work pursuant to a contract for the construction, reconstruction, alteration, remodeling, repair or demolition of any public building or any other public work by the state or a municipality, estimated to cost more than $500,000 and which is funded in whole or in part with state funds, If this requirement is applicable to the project that is the subject of this invitation to bid, bidders shall provide their bid update statement with their bid.

.TIME OF COMPLETION AND LIQUIDATED DAMAGES
Bidders understand and acknowledge that timely completion of the Project is essential. Failure of the Contractor to achieve substantial completion of the Project within the forty five calendar days after award will result in the Owner and the public incurring damages, additional costs and inconveniences that would be impossible or extremely difficult to accurately quantify at the time. Therefore, the bidder and the Town agree that, if the Contractor fails to satisfactorily complete the Project hereunder within the time specified or within any extension of time that may have been allowed, there shall be deducted from any monies due or that may become due the Bidder, the sum of _____ **($_____)** for each and every calendar day, including Saturdays, Sundays and legal holidays, that the Project remains incomplete. This sum shall not be imposed as a penalty, but as liquidated damages due Owner from Contractor by reason of the damages incurred, inconvenience and additional costs and expenses to the public together with other problems suffered as a result of any such delay thereby occasioned.

DISCREPANCY IN BID FORM:
In the event of any discrepancy between the amount written in numerical figures and the amount stated in written words, the amount written in words will be controlling.

The Town of Hamden hereby notifies all bidders that the Town's contract with the successful bidder shall contain the following provision:

Payment to Vendor shall be withheld by the Town when any real or personal property taxes, sewer assessment fees, sewer use charges, fines, interest, penalties, **police or fire extra duty, police vehicle use fees**, or lien fees imposed, assessed or otherwise levied by the Town of Hamden and due from/payable by Vendor are delinquent.

For purposes of this Contract, a tax, fee, charge, or fine shall be deemed delinquent if it remains unpaid, in whole or in part, for a period of thirty (30) days following the date upon which payment of such tax, fee, charge, or fine was due, together with any accrued interest and penalties.

The Town expressly reserves the right, in its sole discretion, to set off against its account payable to Vendor and apply any sums due to Vendor by Town pursuant to this Contract to any delinquent real or personal property taxes, sewer assessment fees, sewer use charges, fines, interest, penalties, or lien fees imposed by the Town of Hamden and due from/payable by Vendor.

TOWN OF HAMDEN
LEGISLATIVE COUNCIL

PRESENTED BY:_____

ORDINANCE AMENDING CONSTRUCTION CONTRACTS ORDINANCE

WHEREAS, the Town of Hamden adopted a local prevailing wage ordinance requiring contractors working on town public works projects to pay laborers and mechanics wages based upon the wages established by the State of Connecticut Department of Labor to be prevailing for the corresponding classes or laborers and mechanics on projects of a similar character to the contract work in town; and

WHEREAS, the threshold for local public works projects covered by the prevailing wage ordinance has not increased since the adoption of the ordinance; and

WHEREAS, the Town wishes to amend its ordinance so that the Town's threshold for prevailing wages is 90% of that set by the Connecticut General Statutes.

NOW THEREFORE BE IT ORDAINED that Section 97.35 (A) of the Hamden Code of Ordinances is hereby amended and restated as set forth below:

CONSTRUCTION CONTRACTS

97.35: WAGES TO BE STATED IN CONTRACT.

(A) The advertised specification for every public works project by the Town of Hamden that is 90% or more of the amount set forth by the Connecticut General Statues, as may be amended, for new construction and/or that is 90% or more of the amount set forth by the Connecticut General Statutes, as may be amended, for remodeling, refinishing, refurbishing, rehabilitation, alteration or repair work, and which requires or involves the employment of mechanics, laborers or workmen employed upon the work contracted to be done, shall contain a provision stating the minimum wages to be paid various classes of laborers, mechanics and workman shall be based upon the wages established by the State through its Department of Labor to be prevailing for the corresponding classes of mechanics, laborers or workmen employed on projects of a character similar to the contract work in the town.

(B) Every contract based upon these specifications shall contain a stipulation that the contractor or his subcontractor shall pay all mechanics, laborers or workmen employed directly upon the site of the work, unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account, the full amount accrued at time of payment, computed at wage rates not less than those stated in the advertised specifications, regardless of any contractual relationship which may be alleged to exist between the contractor or subcontractor and such

laborers, mechanics and workmen, and that the scale of wages to be paid shall be posted by the contractor in a prominent and easily accessible place at the site of the work.

(C) Every contract based upon these specifications shall further stipulate that there may be withheld from the contractor so much of accrued payments as may be considered necessary by the Town to pay to laborers, mechanics and workmen employed by the contractor or any subcontractor on the work difference between the rates of wages required by the contract to be paid laborers, mechanics or workmen on the work and the rates of wages received by such laborers, mechanics or workmen and not refunded to the contractor, subcontractor or other agents.

(D) Every contract based upon these specifications shall contain the further provision that in the event it is found by the Town that any laborer, mechanic or workmen employed by the contractor or any subcontractor directly on the site of the work covered by the contract has been or is being paid a rate of wages less than the rate of wages required by the contract or be paid as aforesaid the Town may, by written notice to the contractor, terminate the contract, terminate the contractor's right to proceed with the work or such part of the work as to which there has been a failure to pay said required wages and to prosecute the work to completion by contract or otherwise, and the contractor and his sureties shall be liable to the town for any excess cost occasioned the town thereby.

MISCELLANEOUS REQUIREMENTS:

Questions/Requests for Information: All Questions shall be submitted in writing only and e-mailed to purchasing@hamden.com by July 21, 2016. Bidders shall not attempt or engage in any ex parte or verbal communications with Town personnel prior to the bid opening deadline.

All Applicable Codes to Be Met: All construction shall meet all applicable Building and Fire Codes, as well as ADA requirements.

Pre-Bid Meeting(s): Failure to attend a mandatory pre-bid meeting may be deemed, by the Town, grounds for rejection of your bid.

Deliveries: All deliveries are inside deliveries.

Provision of Bid Packets, Submission of Bids: Bid packets will be mailed upon request.

Bid packets will not be faxed.

Bid proposals must be mailed back or delivered to:

Hamden Government Center
Finance Department
2750 Dixwell Avenue
Hamden, CT 06518.

Please include one original and ten copies of your bid unless otherwise specified.

ALL ENVELOPES MUST BE MARKED PROPERLY WITH BID #, BID DATE, AND BID TITLE ONLY.

Ownership of Documents – All qualification statements, proposals and bids submitted by bidders are to be the sole property of the Town and subject to the provisions of the Connecticut General Statutes (re: Freedom of Information).

Ownership of Subsequent Products – Any work product, whether acceptable or unacceptable, developed under a contract awarded as a result of this invitation to bid is to be the sole property of the Town unless stated otherwise in the invitation to bid or contract.

Timing and Sequence – Timing and sequence of events resulting from this invitation to bid will ultimately be determined by the Town.

No Oral Agreements – The Town, its agencies and employees, shall not be responsible for any alleged oral agreement or arrangement made by a bidder with any agency or employee of the Town or District.

Rejection for Default or Misrepresentation – The Town reserves the right to reject the bid of any bidder that is in default of any prior contract or for misrepresentation.

Assigning, Transferring of Agreement – Bidders are prohibited from assigning, transferring, conveying, subletting or otherwise disposing of this agreement, their rights, title or interest therein or their power to execute such agreement by any other person, company, or corporation without the prior consent and approval in writing by the Town.

Cost of Preparing Qualification/Proposal Statements – The Town shall not be responsible for any expenses incurred by any bidder in preparing and submitting a bid.

Thank you.

Philip Goodwin
Purchasing Agent

GENERAL BID SPECIFICATIONS - PART B

1. **Nondiscrimination under Title VI of the Civil Rights Act of 1964**. Contractor shall comply with the requirements of Title VI of the Civil Rights Acts of 1964 (PL 88-352), 42 U.S.C. Sec. 2000d et. Seq. and the Fair Housing Act (42 U.S.C. 3601-20) and Executive Order 11063 and the HUD regulations with respect thereto including the regulations under 24 CFR Part I. In the sale, lease, or other transfer of land acquired, cleared or improved with assistance provided under the Agreement, the CONTRACTOR shall cause or require a covenant running with the land to be inserted in the deed or lease or other instrument a restriction prohibiting discrimination with respect to race, color, creed, sex, or national origin, in the sale, lease or rental, or in the use or occupancy of such land or any improvements erected or to be erected thereon and providing that the CONTRACTOR and the United States are beneficiaries of and entitled to enforce such covenant. The CONTRACTOR in undertaking its obligation in carrying out the program assisted hereunder, agrees to take such measures as are necessary to enforce such covenant and will not itself so discriminate.

2. **Fair Housing Opportunities Under Title VIII of the Civil Rights Act of 1968 and Fair Housing Act (42 U.S.C. 3601-20).** Contractor shall comply with the requirements of Title VIII of the Fair Housing Act as amended (PL 90-284). The CONTRACTOR shall provide for fair housing opportunities where possible. The CONTRACTOR is prohibited from discriminating in the sale or rental of housing, the financing of housing, or the provision of brokerage services, including in any way making unavailable or denying a dwelling to any person, because of race, color, religion, sex or national origin. Title VIII further requires programs and activities relating to housing and community development to be administered to affirmatively further fair housing.

3. **Prohibition Against Payments of Bonus or Commission.** The funds paid to Contractor shall not be used in the payment of any bonus or commission for the purpose of obtaining HUD approval of the application for such assistance, or HUD approval of applications for additional assistance, or any other approval or concurrence of HUD required under this AGREEMENT, Title I of the Housing and Community Development Act of 1974, as amended, or HUD regulations with respect thereto; it being understood, however, that reasonable fees or bona fide technical, consultant, managerial or other such services, are not hereby prohibited if otherwise eligible as program costs.

4. **"Section 3" Compliance in the Provision of Training Employment and Business Opportunities.** Every application, recipient, contracting party, contractor, and subcontractor shall incorporate, or cause to be incorporated, in all contracts, the following clause (referred to as a Section 3 clause):

   a) The work to be performed under this contract is on a project assisted under a program providing direct Federal financial assistance from the Department of Housing and Urban Development and is subject to the requirements of Section 3 of the Housing and Urban Development Act of 1968, as amended, 12 U.S.C. 170lu. Section 3 requires that to the greatest extent feasible opportunities for training and employment be given lower income residents of the project area and contracts for work in connection with the project area and contracts for work in connection with the project be awarded to business concerns which are located in or owned in substantial part by persons residing in the area of the project.

   b) The parties to this contract will comply with the provisions of said Section 3 and the regulations issued pursuant thereto by the Secretary of Housing and Urban Development set forth in 24 CFR Part 135, and all applicable rules and orders of the Department issued thereunder prior to the execution of this Contract. The parties to this contract certify and agree that they are under no contractual or other disability, which would prevent them from complying with these requirements.

c) The CONTRACTOR will send to each labor organization or representative of workers with which he has a collective bargaining agreement or other contract or understanding, if any, a notice advising the said labor organization or workers' representative of his commitments under this Section 3 clause and shall post copies of the notice in conspicuous places available to employees and applicants for employment or training.

d) The CONTRACTOR will include this Section 3 clause in every subcontract for work in connection with the project and will, at the direction of the applicant for or recipient of Federal financial assistance, take appropriate action pursuant to the subcontract upon a finding that the subcontractor is in violation of regulations issued by the Secretary of Housing and Urban Development, 24 CFR Part 135. The CONTRACTOR will not subcontract with any subcontractor unless the subcontractor has been found in violation of regulations under 24 CFR Part 135 and will not let any subcontract unless the subcontractor has first provided it with a preliminary statement of ability to comply with the requirements of these regulations.

e) Compliance with the provisions of Section 3, the regulations set forth in 24 CFR Part 135, and all applicable rules and orders of the Department issued thereunder prior to the execution of the Contract, shall be a condition of the Federal financial assistance provided to the project, binding upon the applicant or recipient for such assistance, its successors, and assigns. Failure to fulfill these requirements shall subject the applicant or recipient, its contractors and subcontractors, its successors, and assigns to those sanctions specified by the grant or loan agreement or contract through which Federal assistance is provided, and to such sanctions as are specified by 24 CFR Part 135.

5. **Prevailing Salaries.** The CONTRACTOR shall be solely responsible for the determination of staff classifications and employ staff in relation to its personnel practices and salary ranges, including fringe benefits, in accordance with the Agreement.

6. **Anti-Kickback Rules.** Salaries of architects, draftsmen, technical engineers, technicians, laborers and mechanics performing work under this Agreement shall be paid unconditionally, and not less often than once a week, without deductions as are mandatory by law or permitted by the applicable regulations issued by the Secretary of Labor pursuant to the Copeland "Anti-Kickback Act" (18 U.S.C. 874) as supplemented in Department of Labor regulations (29 CFR, Part 3). The CONTRACTOR shall comply with all applicable regulations of said "Anti-Kickback Act" and shall insert appropriate provisions in all subcontracts relative to the work under this Agreement; and CONTRACTOR shall take steps to insure compliance by subcontractors with such regulations at all times. CONTRACTOR shall be responsible for the obtaining and submission of the affidavits of subcontractors required thereunder, except that the Secretary of Labor may specifically provide for variations of, or exemptions from, the requirements thereof.

7. **Non-Discrimination in Employment.** During the performance of this Contract, the CONTRACTOR agrees as follows:

a) The CONTRACTOR shall not discriminate against any employee or applicant for employment because of race, creed, color, sex or national origin. The CONTRACTOR shall take affirmative action to insure that applicants are employed and that employees are treated during employment without regard to their race, creed, color, sex, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion, transfer, recruiting or recruitment advertising, layoff, termination, rates of pay or other forms of compensation, and selection for training including apprenticeship. The CONTRACTOR agrees to post in conspicuous places available to employees and applicants for employment notices to be provided, setting forth the provisions of this Non-Discrimination in Employment Clause.

b) The CONTRACTOR shall, in all solicitations or advertisements for employees placed by or in behalf of the CONTRACTOR; state that all qualified applicants will receive consideration for employment without regard to race, creed, color, sex, or national origin.

c) The CONTRACTOR shall comply with all provisions of Executive Order 11246 of September 24, 1965, entitled "Equal Employment Opportunity", as amended by Executive Order 11375 and Executive Order 12086, as supplemented in Department of Labor Regulations (41 (CFR, Part 60), and all of the rules, regulations and relevant orders of the President's Committee of Equal Employment Opportunity in effect as of the date of this Agreement; and the CONTRACTOR shall furnish all information and reports required herein, and shall on demand permit access to its books, records, and accounts, in its possession or control, by TOWN and the said Committee for purposes of investigation to ascertain compliance with such rules, regulations and orders.

d) The CONTRACTOR will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided by the Contract Compliance Officer advising the said labor union or workers' representative of the CONTRACTOR'S commitment under this section and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

e) In the event the CONTRACTOR'S noncompliance with the non-discrimination sections of the contract or with any of such rules, regulations, or orders, this contract may be canceled, terminated or suspended in whole or in part and the CONTRACTOR may be declared ineligible for further Government contracts or federally assisted construction contract procedures authorized in Executive Order 11246 of September 4, 1965, or by rule, regulations, or order of the Secretary of Labor, or as otherwise provided by law.

f) The Contractor will include the portion of the sentence immediately preceding paragraph (a) and the provisions of paragraph (a) through (g) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order 11246 of September 25, 1965, as amended by Executive Order 11375 and 12086, so that such provisions will be binding upon each subcontractor or vendor. The CONTRACTOR will take such action with respect to any subcontractor or purchase order as the Department may direct as a means of enforcing such provisions, including sanctions for noncompliance; provided, however, that in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the Department, the contractor may request the United States to enter into such litigation to protect the interest of the United States.

g) The CONTRACTOR further agrees that it will refrain from entering into any contract or contract modification subject to Executive Order 11246 or September 24, 1965, as amended by Executive Orders 11375 and 12086, with a subcontractor debarred from, or who has not demonstrated eligibility for, Government contracts and federally assisted construction contracts pursuant to the executive order and will carry out such sanctions and penalties for violation of the equal opportunity clause as may be imposed upon CONTRACTOR and subcontractors by the Department of the Secretary of Labor pursuant to Part II, subpart D of the Executive Order.

h) No person in the United States shall on the ground of race, color, national origin, or sex be excluded from participation in, be denied the benefits of, or be subjected to the discrimination under any program or activity funded in whole or in part with funds made available under this title. Any prohibition against discrimination on the basis of age under the Age Discrimination Act of 1975, as amended, or with respect to an otherwise qualified handicapped individual as provided in Section 504 of the Rehabilitation Act of 1973, as amended, shall also apply to any such program or activity. Remedies described in Section 109 of the Housing and Community Development Act

of 1974, as amended, as the regulations issued pursuant thereto, (24 CFR Section 570.601) shall apply, if failure to comply with this paragraph has been determined.

8. **Employment of Certain Persons Prohibited**. No person under the age of sixteen years and no person who at the time is serving sentence in a penal or correctional institution shall be employed on the work covered by this Contract.

9. **Uniform Relocation Assistance and Real Property Acquisition Policy Act of 1970 and Federal Implementing Regulations**. Contractor and Owners shall to the greatest extent practicable under state law comply with Sections 301 and 302 of Title III, (Uniform Real Property Acquisition Policy) of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 and will comply with Sections 303 and 304 of Title III and HUD implementing instructions in 24 CFR Part 42 and 570.602 (b), comply with Title II (Uniform Relocation Assistance) of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 and HUD implementing regulations at 24 CFR Part 42 and 570.602 (a).

10. **Political Activity Hatch Act and Section 109 of HCD Act**. CONTRACTOR shall comply with the provisions of the Hatch Act and Section 109 of the Housing and Community Development Act of 1974, as amended, and the regulations pursuant thereto (24 CFR 570.601). Under no circumstances shall the CONTRACTOR and/or other recipients, subcontractors, and sub recipients use TOWN funds or persons employed in administering TOWN programs for the purposes of conducting any political activity.

11. **Executive Orders 11063, 12259, and Title VIII**. CONTRACTOR will comply with Executive Order 11063 as amended by Executive Order 12259 and the implementing regulations in 24 CFR Part 107 and Title VIII of the Civil Rights Act of 1968 (Pub. L.90-284) as amended.

12. **Historic Preservation**. CONTRACTOR will comply with the National Historic Preservation Act of 1966 (PL 89-665), Preservation of Historic and Archaeological Data Act of 1974 (PL 93-291), Procedures for Protection of Historic and Cultural Properties, Advisory Council on Historic Preservation (36 CFR 800), and the HUD regulations with respect thereto.

13. CONTRACTOR will comply with HUD Section 504 of the Rehabilitation Act of 1973 (29 U.S.C. 794 et. seq.) provides:

    No otherwise qualified individual with handicaps . . . shall, solely by reason of his or her handicap be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financing assistance.

14. **No Conflict of Interest:** Bidder certifies, by submitting a bid, that no owner, employee or family member (defined for purposes of this invitation to bid as a spouse, parent, sibling or child) of an owner or employee of bidder is a current or former employee of the Town or its Board of Education.

    Bidder further certifies that no owner or employee of bidder has any interest, direct or indirect, which is incompatible with the proper discharge of the proposed duties in the public interest or that would tend to impair Bidder's independent judgment or action in the performance of the proposed duties.

    Bidder certifies that it does not have any past, present or currently planned interests which are an actual or potential organizational conflict of interest with respect to performing the work for Town under this invitation to bid.

Bidder hereby covenants and agrees that no employee, elected official or appointed official of the Town or its Board of Education has any interest in this Agreement or will directly or indirectly benefit therefrom.

15. Compliance with Town Regulations

Bidder shall cause all persons performing work pursuant to the contract between bidder and the Town to comply with all Town and Board of Education requirements, including instructions pertaining to conduct and to building access and related requirements issued by the Town and District, respectively. All personnel shall wear readily visible identification in a form that is satisfactory to the Town. The Town may promulgate and modify from time to time rules and regulations relating to conduct as the Town, in its sole discretion, may determine, and the contractor shall cause all persons performing work to comply with any such requirements.

16. Confidential Information

Bidder shall cause all persons under bidder's control who are providing services or materials under or through bidder's contract with the Town to preserve and protect all information of the Town and Hamden School District to which they may have access during the performance of work as confidential. Bidder expressly acknowledges that if the facilities that are the subject of the Project are school facilities or public buildings, the security and safety of the occupants, users and general public are of paramount importance and bidder shall observe and enforce appropriate security protocol to ensure the safety of users and occupants.

COMPLETE AND RETURN

BID #: 2814
BID TITLE Hamden High School Locker Room Rooftop Heating/Ventilat Project

BID FORM

TO: Purchasing Agent
Hamden Government Center
2750 Dixwell Avenue
Hamden, CT 06518

I have received the bid documents entitled _____
and dated _____.

I have received Addenda dated as follows:
_____

I have considered and included the provisions of the bid documents noted above in my bid. I have examined the bid documents and I submit the following BID:

In submitting this bid, I agree:

1. To hold my bid open until 90 days after the date on which bids are due.

2 To enter into and execute a contract provided by the Town, without alteration by me, if awarded on the basis of this bid, according to the contract form provided by the Town of Hamden.

3 To accomplish the work in accord with the Bid Specifications and Contract Documents and to the extent that there is a conflict between the provisions of any bid documents, the order of precedence shall require me to provide the item or service that is of the greater value or benefit to the Town of Hamden.

4. To begin the work in strict accordance with the project schedule or the Notice to Proceed issued by the Town and to complete the work within _____calendar days following Owner's date of Notice to Proceed.

5. The undersigned submits a bid bond in the sum of _____ _____ dollars ($ _____) 5% of Base Bid, which sum is agreed shall become the sole and exclusive property of the Owner as liquidated damages to the Owner if the undersigned fails to execute a contract in conformity with the Bid Form and to furnish surety bonds and insurance policies in accordance with the General Conditions after due notification has been given.

6. I acknowledge that the Town of Hamden reserves the right to accept or reject any or all bids, alternates, options, or proposals; to waive any technical defect in a bid or part thereof submitted, and to accept the bid deemed by the Town to be in the best interest of the Town of Hamden.

_____ _____
Name: Dated
Title:

_____ _____

Contractor Tax ID#

Contractor License #

COMPLETE AND RETURN

BID #: 2814
BID TITLE: Hamden High School Locker Room Rooftop Heating/Ventila Project

NON-COLLUSIVE BID STATEMENT

The undersigned bidder, having fully informed itself regarding the accuracy of the statements herein, certifies that:

(1) The bid has been arrived at by the bidder independently and has been submitted without collusion with, and without any agreement, understanding, or planned common course of action with, any other vendor or bidder of materials, supplies, equipment, or services described in the invitation to bid, designed to limit independent bidding or completion, and

(2) The contents of the bid have not been communicated by the bidder or its employees or agents to any person not any employee or agent of the bidder or its surety on any bonds furnished with the bid and will not be communicated to any such person prior to the official opening of the bid.

The undersigned bidder further certifies that this statement is executed for the purposes of inducing the Town of Hamden to consider the bid and make an award in accordance therewith.

_____
Legal Name of Bidder

_____
Business Address

_____
Signature and Title of Person
Authorized to Sign

_____
Printed Name

_____
Date

COMPLETE AND RETURN

BID #2814

You are required to furnish the following information to the Town of Hamden:

Name and address of Company _____
(Print or type)

_____

_____

Name and Title of Agent of Company _____
(Print or type)

Signature: _____ Date: _____

Telephone: _____ Email: _____

Fax: _____ Federal I.D. Number: _____

Lump sum price for equipment, material, and labor: $_____

$_____
WRITTEN AMOUNT