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NOTICE TO BIDDERS
ADDENDUM #002

TO THE BID FOR: B017-02 New Air Conditioning System at Pulaski Elementary School

FOR: City of Meriden

BID OPENING DATE: **August 31, 2016 at 2:00 PM**

Please acknowledge receipt of all addenda on the Proposal Pages.

The purpose of this addendum is to:

1. Answer RFIs and provide additions/clarifications.

Wilma C. Petro, CPPB, C.P.M.
Purchasing Officer

Dated: August 26, 2016

ADDENDUM 2

DATE: 8-26-2016

GENERAL

1. xxx

SPECIFICATIONS

1. **Add** Section 23 09 13 – Instrumentation and Controls for HVAC
2. **Add** Section 23 31 13 – Metal Ducts.
3. Specifications Section 23 07 00 – HVAC insulation **Add:** Paragraph 2.4
   SOUND LINING:

   A. Line ductwork as indicated on drawings for sound attenuation. Use 1" thick John Manville permacote linacoustic standard flexible duct linear with an R value of 4 and NRC value of 0.7.

   Liner shall be applied with bonding adhesive and stick clips 16" o.c. Where ducts are lined, covering need not be applied. All raw edges shall be sealed with John Manville super seal.

   B. Linings in air ducts and equipment shall meet the Erosion Test Method described in Underwriters' Laboratories, Inc., Publication No. 181. These linings, including coatings and adhesives, and insulation on exterior surfaces of pipes and ducts in building spaces used as air supply plenums, shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less as determined by an independent testing laboratory in accordance with ASTM Standard E 84. Ducts in the unheated Attic shall be covered with 3" of foil faced insulation, with an "R" value of 8.

   C. All dimensions shown on insulated ductwork shall be considered clear inside dimensions.

DRAWINGS

1. Drawing MD-2 – Upper Gym/Auditorium **Add:** Remove and Replace existing backdraft dampers associated with existing roof mounted exhaust fans (typical of 2).
2. Drawing MD-2 Mechanical Demolition Work Symbols **Add:** for note 8, include remove existing circulating pump and accessories.
3. Drawing M-2 – Ductless Split System Schedule and diagram **Revise:** Refer to attached ADD-SKM-1
4. Drawing M-2– Floor plan **Add:** All the supply oval duct associated with the new Roof Top Units shall be perforated double wall construction. All the rectangular supply duct associated with the new Roof Top Units shall be lined.
5. Drawing M-2 – Packaged RTU Schedule **Add:** Unit manufacturer shall provide dual enthalpy economizer.
6. Drawing M-2 – Packaged RTU Schedule **Add:** Unit manufacturer shall provide GFI service outlet.
7. Drawing M-2 – Packaged RTU Schedule **Revise:** Contractor shall provide 24" high vibration

isolating curb with sound attenuating package.

8. Drawing M-2 – Packaged RTU Schedule **Add:** Contractor shall provide OSHA compliant, self ballasted fall protection guard rail SafetyRail 200 by Blue Water
9. Drawing ED-2 – Community Storage **Add:** Contractor shall temporarily remove existing ceiling grid, ceiling tiles and light fixtures. Store at a safe location for future installation.
10. Drawing ED-2 Electrical Demolition Work Symbols **Add:** for note 4 include disconnecting power to existing circulating pump.
11. Drawing E-2 – Upper Stage/Cafeteria **Clarification:** The two weather proof GFI outlets are located on the roof. This contractor shall provide pitch box.

Questions

1. Since the building will be occupied, is all work inside the building done on 2nd shift/school shutdowns? Will the work on the roof be required to be done on 2nd shift/school shutdowns?

Answer: The intent is to have the work in the school done on second shift or school shutdowns. The Work on the roof shall be done when the school is unoccupied, on 2nd shift or during school shutdown.

2. On drawing MD-1 – Note #1 says to remove Linear, cut back below floor, cap and patch to match existing floor. This was questioned at the pre bid meeting. Are we just removing the Linear Grille and capping the duct at floor level without doing any floor patching/matching? Also notes #1 & #3 state to fill abandoned below floor duct with concrete. Is this actually required?

Answer: Remove the grille, cap and seal opening, fill duct with concrete.

3. Is there a specification for ductwork? Is the oval in the cafeteria/Gym single wall or double wall?

Answer: Please refer to attached Specifications section 23 31 13 Metal Ducts. Oval duct shall be double wall construction

4. Is there a temperature control specification?

Answer: Please Refer to attached Specifications Section 23 09 13 Instrumentation and Controls for HVAC

SECTION 23 09 13 INSTRUMENTATION AND CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. The General Requirements in Sections 20 00 50 shall also govern the work under this Section.

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

1.2 GENERAL REQUIREMENTS

Description – **This specification for a Building Automation System (BAS) as detailed herein shall be strictly enforced.** Provide a Building Automation System (BAS) incorporating LonMark certified LONWORKS devices communicating over a Local Operating Network (LON) or BACnet Testing Laboratories (BTL) certified BACnet devices communicating over a Master-Slave Token Passing (MSTP) network at the field level and Niagara AX based network managers at the network level. The Niagara AX based network managers shall bridge the Lonworks and/or BACnet/MSTP field communications network to the owner's Local and/or Wide Area Network, as designated by the owner, and shall communicate seamlessly with the other Niagara AX based devices on the owner's enterprise-wide BAS network. The BAS shall consist of Direct Digital Control (DDC) controllers, Building Controllers (BC), network management tools, programming tools, web browser based Graphical User Interface, sensors, relays, valves, actuators, and other equipment as may be necessary to provide for a complete and operational control system for the HVAC and other building related systems as described within these specifications.

The system installed shall seamlessly connect devices other than HVAC throughout the building regardless of subsystem type, i.e. HVAC, lighting, and power systems devices should easily coexists on the same network channel without the need for gateways. LONWORKS or BACnet components not supplied by the primary manufacturer of the BAS shall be integrated to share common software for network communications, time scheduling, alarm handling, and history logging.

The documentation contained in this section and other contract documents pertaining to HVAC Controls is schematic in nature. The Contractor shall provide hardware and software necessary to implement the functions shown or as implied in the contract documents.

System configuration and monitoring shall be performed via a PC-type computer. Under no circumstances shall the PC be used as a control device for the network. It can be used for storage of data.

Open Systems Design - It is the owners expressed goal to expand/extend the existing NiagaraAX platform currently installed and to have all buildings under the responsibility of the MBOE to be fully configured, programmed and functional through the existing Campus Wide Supervisory Server. The BAS provided shall maintain open interoperability in the following areas.

Communications - 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 communication protocols in one open, interoperable system. Where existing systems using proprietary protocols exist, a gateway or driver may be incorporated to provide for interoperability.

Network Management - Network management tools shall be based upon Niagara Framework technology as developed by the Tridium Corporation. All tools and hardware provided shall comply with the current release of the AX Niagara Framework platform.

User Access - The supplied system must incorporate the ability to access all data using standard Web browsers without requiring a proprietary operator/user interface and configuration programs.

Databases - All controller program graphics and network databases shall be provided in a Niagara Framework AX format. The database shall be stored on the existing owner server and provided on a separate memory device upon final acceptance of the project. An updated database shall be provided on a memory device at the end of the warranty period.

Building Controllers (BC) - All BCs (devices that provide for communication between the field level controllers and the owner's wide and/or local area network, and manage facility global functions such as alarms, trends, schedules and normalization of data) shall conform to the current release of the Niagara AX Framework. All BCs shall be furnished with extended memory. No BC shall be provided with less than 128 MB of RAM. The number of BACnet or Lonworks nodes (controllers) attached to any Niagara AX based network manager shall not exceed the following limits:

COMBINED MEMORY	MAXIMUM NUMBER OF NODES
128 MB SDRAM/64 MB SERIAL FLASH	15
256 MB DDR RAM/128 MB SERIAL FLASH	50
1 GB DDR2 RAM/1 GB SERIAL FLASH	125

Regardless of the maximum number of nodes indicated above, it is ultimately the exclusive responsibility of the systems integrator/building controls contractor to ensure that the BC has adequate resources for the number of nodes (controllers) attached to it.

All Niagara AX Network Manager controllers (BC) shall be integrated into the existing MBOE Campus Wide Supervisory Server. All local control programming shall reside on the network managers to maintain standalone control and all system wide programming and all graphical images shall be hosted and served by the supervisory server. The Owner will supply all required static IP address' as necessary to accommodate multiple BC's per building.

Direct Digital Controllers (DDC) - All DDC devices for HVAC and lighting control, with the exception of DDC device furnished as part of the OEM control package, shall be certified to the current LONMARK and BTL standards appropriate to their application provided an appropriate LONMARK or BTL Certification standard exist. All points within a controller including hard I/O and software based points shall be available for viewing, management, and manipulation through the Niagara Framework tools.

Software Tools - All software tools needed for full functional use, including programming of BCs and DDC, network management and expansion, and graphical user interface development, of the BAS described within these specifications, shall be provided to the owner or his designated agent. Any licensing required by the manufacturer now and into the future, including changes to the licensee of the software tools and the addition of hardware corresponding to the licenses, to allow for a complete and operational system for both normal day to day operation and servicing shall be provided. Any such changes to the designated license holders shall be made by the manufacturer upon written request by the owner or his agent. Any cost associated with the license changes shall be identified within the BAS submittals.

Programming Tools - Provide freely available Niagara AX Wizards to facilitate the programming and configuration of all of the DDC devices that are provided for the HVAC and lighting control. Wizards shall be provided free of charge and be compatible with the current published versions of the network management tool that is provided as part of this project. The wizard software shall be available for public access from the manufacturer's web site. These wizard programming tools shall be compatible with at least 3 other brands of the Niagara Framework network management tools. The SI shall demonstrate as part of their prequalification as to how they intend to comply with these requirements.

Software License Agreement - The Owner shall sign a copy of 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 as it relates to disclosure of trade secrets contained within said software. 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, databases and documentation for all configuration and programming that is generated for a given project and/or configured for use with the BC, BAS 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 System Integrator shall provide as part of the submittals a copy of the Niagara Compatibility Statement (NiCS) verifying that all aspect of the Niagara Framework as provided maintain an Open System Design. The System as provided shall confirm with the following NiCS

Property	Value
STATION COMPATIBILITY IN	All
STATION COMPATIBILITY OUT	All
TOOL COMPATIBILITY IN	All
TOOL COMPATIBILITY OUT	All

Quality Assurance

General - The HVAC Control System shall be furnished, engineered, and installed by a licensed Controls Contractor or System Integrator (SI). All work provided under this section shall be provided by direct employees of the SI or under the direct supervision of the SI personnel.

System Integrator Qualifications

The SI must be regularly engaged in the service and installation of LONWORKS , BACnet, and Niagara AX based systems as specified herein, The SI shall have a minimum of 5 years experience in the sales, installation, engineering, programming servicing and commissioning of the Niagara^{AX} platform and the field controllers as proposed

The system integrator must be an <u>authorized factory direct representative</u> in good standing of the manufacturer of the proposed hardware and software components. Provide a letter dated within the last 6 months, from the manufacture certifying that the System Integrator is an authorized factory direct representative.

The SI shall have an office within 20 miles of the Building site that is staffed with a minimum of five (5) technicians who have successfully completed the factory authorized training of the proposed manufactures hardware and software components and have successfully completed a Niagara AX certification course. SI must provide proof of required training. The SI capabilities shall include engineering and design of control systems, programming, electrical installation of control systems, troubling shooting and service.

The SI shall submit a list of no less than three (3) similar projects, which have similar Building Automation Systems as specified herein installed by the

SI. These projects must be on-line and functional such that the Owner's/User's representative can observe the system in full operation.

Hardware and Software Component Manufacturer Qualifications

The manufacturer of the hardware and software components must be primarily engaged in the manufacture of both LonWorks and BACnet based systems as specified herein, and must have been so for a minimum of three (3) years. The manufacturer shall demonstrate that they are the manufacturer of all DDC devices and Niagara AX products provided.

The manufacturer of the hardware and software components as well as its subsidiaries must be a member in good standing of the LONMARK Association, BACnet International, and the BACnet Manufacturers Association.

The manufacturer of the hardware and software components shall have a technical support group accessible via a toll free number that is staffed with qualified personnel, capable of providing instruction and technical support service for networked control systems.

Submittals

Submit 6 complete sets of documentation in the following phased delivery schedule:

1. Valve and damper schedules
2. Equipment data cut sheets
3. System schematics, including:
   a. sequence of operations
   b. point names
   c. point addresses
   d. point to point wiring
   e. interface wiring diagrams
   f. panel layouts
   g. system riser diagrams
. 4. Visio® or AutoCAD compatible as-built drawings

Upon project completion, submit operation and maintenance manuals, consisting of the following:

1. Index sheet, listing contents in alphabetical order
2. Manufacturer's equipment parts list of all functional components of the system, disk of system schematics, including wiring diagrams
3. Description of sequence of operations
4. As-Built interconnection wiring diagrams
5. User's documentation containing product, system architectural and programming information.
6. Trunk cable schematic showing remote electronic panel locations, and all trunk data
7. List of connected data points, including panels to which they are connected and input device (ionization detector, sensors, etc.)
8. Copy of the warranty

9. Recommended spare parts list

Training - Meet all applicable Training requirements of Division 1, Division 15, and the following.

Instruct the operators how to accomplish control of the system. Include basic troubleshooting and override of equipment and controls in the event of system failure.

Training Allowance: Provide not less than 40 hours formal training to the Owner's designated operations personnel.

Trainers - Persons conducting the training shall hold a Niagara AX certification, be knowledgeable in the workings of the system, and shall be regularly engaged in training exercises, so as to provide effective training.

Training Classes - Prior to conducting training, prepare and submit for approval the proposed training literature and topics. Submit this information at least two weeks prior to the first class.

Training - Manufacturer provided training on the use and operation of all products provided within these specifications shall be available for purchase and attendance by the Owner or his designated agent. Such training shall be of the same curriculum as the training courses provided by the manufacturer to the System Integrator. A manufacturer advanced AX certified instructor shall give all training classes. A list of training courses and the associated cost shall be provided as part of the BAS submittals.

Warranty

The HVAC Control System shall be free from defects in workmanship and material under normal use and service. If within eigfhteen (18) months from the date of substantial completion or the owner receives beneficial use of the system, the installed equipment is found to be defective in operation, workmanship or materials, the building systems contractor shall replace, repair or adjust the defect at no cost. Service shall be provided within the next business day upon notice from Owner's designated Representative.

The warranty shall extend to material that is supplied and installed by the Contractor. Material supplied but not installed by the Contractor shall be covered per the above to the extent of the product only. Installation labor shall be the responsibility of the trade contractor performing the installation.

All corrective software modifications made during warranty service periods shall be updated on all user documentation and on user and manufacturer archived software disks.

1.7 OWNERSHIP OF PROPRIETARY MATERIAL

A. Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:

1. Graphics
2. Record drawings
3. Database
4. Application programming code
5. Documentation
6. Provide to the owner the highest level administrative password for the system. This password is to be filed away by the owner and not used during the warranty period. This is to protect the owners' interest in the system they purchased.

PART2 – PRODUCTS

2.1 Acceptable Manufactures

A. Distech by Connecticut Temperature Controls. (860) 953-1862. The new system shall be an extension of the existing new addition Network Manager located in the new mechanical room and campus wide supervisory server located at the Meriden Board of Education building.

B. Controls shall be microprocessor based Interoperable **NiagaraAX** Controllers in accordance with the JSR-60 Baja Specification. Inclusion on this list does not guarantee acceptance of products or installation. Control systems shall comply with the terms of this specification.

1. The Contractor shall use only operator workstation software, controller software, custom application programming language, and controllers from the corresponding manufacturers and product line. The use of field level controllers from multiple manufacturers is acceptable provided no proprietary configuration or programming software is needed. **All field level controllers must be fully configurable through the NiagaraAX automation level controller and the existing NiagaraAX Campus Wide Supervisory Server. No additional tools, software or links to other servers/computers/systems shall be installed on this server.**
2. Other products specified herein (such as sensors, valves, dampers, and actuators) need not be manufactured by the above manufacturers.

2.2 Networks – All Niagara AX based network managers supplied under this section shall bridge the Lonworks, BACnet or ModBus field bus to the owner's Local Area Network (LAN) and/or Wide Area Network (WAN) as designated by the owner. The network managers shall communicate at no less than 100 Megabits/sec over the Ethernet network and shall support BACnet over IP, Java, XML, HTTP, Fox and SOAP for maximum flexibility as it relates to the integration of building data with enterprise information systems. The system shall provide support for multiple network managers, Building Controllers (BC),

user workstations and shall be fully configured through the exist campus wide site supervisor. The WAN and/or LAN will be provided by others. The SI shall coordinate with the General Contractor for the access to the WAN and/or LAN.

A. Network minimum physical and media access requirements:
   1. Ethernet; IEEE standard 802.3
   2. Cable; 100 Base-T, UTP-8 wire, category 5 Minimum throughput; 100 Mbps

B. Network Access - Remote Access - For Local Area Network installations; provide access to the WAN and/or LAN from a remote location, via the Internet. This connection already exists to the existing campus wide site supervisor. The owner will provide a WAN

2.3 Network - Field Level Controllers – The communication network between the field level controllers shall be Lonworks TP/FT 10 bus topology, BACnet MSTP, BACnet/IP, Modbus RS-485 or Modbus/IP. All wiring shall be provided in accordance with the standards for the appropriate protocol. The number of devices on any one network shall not exceed 90% of capacity.

2.4 Network Management Devices – These various devices will service multiple functions on the network depending on network design, communication medium and needed task. These functions can include: management of traffic on the network, reconfiguring and strengthening of signals, the conversion of protocols, normalizing of data, global management of alarms, trends and schedules, control logic, protocol conversion and web page hosting for use as a Graphical User Interface.

A. Building Controller (BC) – This Niagara Framework based device 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 BC.

   1. It shall be provided with these features
      a. Web page hosting
      b. Extended memory
      c. Network management tools resident within the BC (optional)
      d. Appropriate hardware and driver(s) associated with the protocol it manages
      e. Din rail mounted power supply
   2. Provide multiple Building Controllers as necessary. In order to maintain peak performance of the network, limit the maximum consumed resources to 80 percent as indicated by the resource meter resident in the network management tools.
   3. 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. Manage alarms as defined in the points list.
   4. Provide timed (schedule) routing of alarms by class, object, group, or node.

5. Provide 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. Control equipment and network failures shall be treated as alarms and annunciated.
6. Alarms shall be annunciated in any of the following manners as defined by the user:
   a. Screen message text
   b. Email of the complete alarm message to multiple recipients.
      Provide the ability to route and email alarms based on:
      1.Day of week
      2.Time of day
      3.Recipient
   c. Pagers via paging services that initiate a page on receipt of email message
   d. Graphic with flashing alarm object(s)
   e. Printed message, routed directly to a dedicated alarm printer
7. The following shall be recorded by the BC for each alarm (at a minimum):
   a. Time and date
   b. Location (building, floor, zone, office number, etc.)
   c. Equipment (air handler #, access way, etc.)
   d. Acknowledge time, date, and user who issued acknowledgement.
   e. Number of occurrences since last acknowledgement.
8. Alarm actions may be initiated by user defined programmable objects created for that purpose.
9. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
10. A log of all alarms shall be maintained by the BC and/or a server (if configured in the system) and shall be available for review by the user.
11. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
12. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
13. Data Collection and Storage - The BC shall collect data for any property of any object and store this data as defined in the points list.
14. The data collection shall be performed by log objects, resident in the BC that shall have, at a minimum, the following configurable properties:
15. Designating the log as interval or deviation.
16. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
17. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.

18. 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.
19. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.
20. Audit Log - Provide and maintain an Audit Log that tracks all activities performed on the BC. 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 BC), to another BC on the network, or to a server. For each log entry, provide the following data:
    a. Time and date
    b. User ID
    c. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

B. LON to LON and Bacnet Routers and Repeaters – A router or repeater may be used on a LON segment between controllers and a BC as a means to manage traffic and reconfigure and strengthen a transmission signal. Routers shall be fully programmable and permit a systems integrator to define message traffic, destination, and other network management functions utilizing LONWORKS. A repeater or signal booster may only be used to increase ths signal strength of the communictions. Under no circumstances may it be used in the place of a router.

C. Campus Wide Server Supervisor – The entire building management system shall be integrated into the existing Niagara AX campus wide supervisor located at the Board of Education Building. All programming and configuration on the existing Niagara AX Web Supervisor must be performed by Connecticut Temperature Controls as this company is responsible for this software's proper function and energy performance under a current contract with the MBOE. Connecticut Temperature Controls must perform all work on this software and server. This Contractor shall include all costs associated with the server integration and programming.

PART 3- BUILDING AUTOMATION SYSTEM CONTROLLERS

3.1 All controllers shall be designed for easy installation and servicing including removable enclosures, removable terminals, and factory applied labels for all I/O.

All internal points within the Programmable Controllers shall be fully supported by the Graphical User Interface (GUI), allowing the user to easily modify them and monitor them. All of the internal programming points (e.g. variables, constants, PID's, timers, inputs and outputs) shall be exposed to the network on dedicated network variable outputs. All controllers programs and schedules shall contain non-volatile flash memory. Upon a loss of power all controllers shall perform a self restart.

3.2 Programmable Controllers (PC) – a controller designed for more complex sequences of operations such as built up AHU, central plant operations, electrical monitoring, and control and management for chillers, boilers and generators. The PCs are to allow for the flexibility of custom control programming to meet the needed sequences of operation.

B. Performance – Each PC shall have a minimum of 64K of Non-volatile Flash memory for control applications and 128K non-volatile flash memory for storage with a 8 bit processor. The PC shall have a minimum ambient operating temperature range of -0°C to 70°C or 32°F to 158°F.

C. Inputs – Analog inputs shall have the following minimum level of performance: 16-bit A to D resolution; allow monitoring of platinum 100 ohms, platinum 1000 ohm, nickel 1000 ohms, thermistor 10K type II, thermistor 10K type III, voltage input 0-10VDC, current input 4-20mA, digital input, pulsed input minimum 2 Hz.

D. Outputs – Outputs shall be either software configurable to be either analog or digital or dedicated digital only - Analog outputs shall be selectable as voltage of 0-10 VDC (linear) or 4-20mA or Digital outputs shall be 0-12 VDC (off/on), floating or PWM. Outputs shall have an adjustable range of 2 seconds to 15 minutes. Output Resolution shall be a minimum 8 bits digital / analog converter. All individual outputs and power supply shall be protected by an auto reset fuse. There shall be an LED status indicator on each of the outputs.

E. Programmable Controller Features

1. Provide an onboard network communication jack
2. The PC shall be provided with a diagnostic indicator lights for power and network communication of transmit and receive along with a light indication position for each output
3. LCD Operator Interface – For all controllers applied to a AHU, Chiller, Pumps Cooling Tower or Boiler Plant, provide a controller with a fully integrated LCD interface for manual override and adjustment of all Analog and Digital outputs. The LCD Operator interface shall be an integral part of the controller. LCD interface external from the controller shall not be accepted.
4. Enclosures – Provide for an enclosure with a separate back plate with terminals such that the electronic portion of the controller can be easily removed for ease of installation and servicing.

3.3 Configurable Controllers (CC) - A controller designed through its I/O configuration and configurable control logic to be used for a specific type mechanical equipment.

B. Performance: Inputs Provide software selectable universal inputs. Analog inputs - shall have the following minimum level of performance: 16 bit A to D resolution for all terminal box applications, 12 bit A to D resolution for all other configurable applications, manage thermistors with an accuracy of: ±0.5^{o}C; ±0.9^{o}F, and a Potentiometer

C. Output – Analog outputs shall have the following minimum level of performance: Tri-mode Voltage of 0-10 VDC (linear), digital 0-12 VDC (off/on) or PWM. All analog outputs shall be equipped with an auto reset fuse. Output Resolution shall be a minimum 8 bits digital / analog converter. Digital outputs shall be provided with a minimum of a triac output rated at 24VAC and 1 amp. All analog outputs shall be fuse protected

D. CC Features:

1. The CC except for the VAV shall be provided with an optimum start program internal to its control logic. The optimum start shall be activated by a event signal from its associated scheduler on the network.
2. The CC shall allow the use of its spare I/O as dumb I/O to be shared over the network to other controllers such as PC or the Building Controller (BC), where a sequence of operation can be applied to the I/O. Such applications shall include but not be limited to exhaust fan control, heaters, light control, etc.
3. Enclosures – Provide for all CC except for the VAV, an enclosure with a separate back plate with terminals such that the electronic portion of the controller can be easily removed for ease of installation and servicing.

3.4 Special Purpose Configurable Controllers (SPCC) – A controller designed with unique functions and featues particular to a specific type of mechanical equipment or applications that may be less common and or standarizied in its use and application.

B. SPCC – Thermostat (SPCCT) – A self contained controller with a built-in user interface that is intended for installation in the occupied space of the building. The SPCCT shall have the following features:

1. The SPCCT shall be a microprocessor based controller with all of its control logic, sensors, inputs and outputs, network communication and user interface provided within a manufacture provided enclosure specific to the application. The enclosure shall be aesthetically appealing with a modern design that will fit in with the architecture of the building. A sample of the SPCCT shall be provided as part of the submittal process.
2. The SPCCT shall be programmed through the user interface contained within the controller and through the LNS plug-in.
3. The User interface display shall be provided with 3 levels of password protection: Level 1 – Lockout with view only and time adjustment; Level

2 - schedule override and mode settings; Level 3 – full access to all parameters. The display shall be back lighted for easy viewing.

4. The SPCCT shall utilize a PI (proportional and integral) control algorithm. Upon power failure, all programmed schedules and parameters must be retained in non volatile flash memory. Progressive temperature recovery shall be a standard feature. Two configurable digital/binary inputs will be available as well as two remote temperature sensor inputs for outdoor air and remote room/return air monitoring. Built-in frost protection, which can be disabled, will energize the heating as soon as the ambient temperature falls below 45°F (5°C). An auxiliary digital/binary output, which can be configured for normally open or normally closed operation, will also be available.

C. Lighting Control (SPCC-LC) – A standalone microprocessor based control panel that contains line and or low voltage relays for control of the lighting circuits along with the appropriate schedules and local user interface.

1. The SPCC-LC shall provide as a minimum the following functionality;
   1. Occupant-Sensitive Operating Scenarios
   2. Schedule With Flick Warn
   3. Time-delay Overrides With Flick Warn
   4. Common Area Interlock With Egress Timer
   5. Master Switch Control With Flick Option
   6. Cleaning Lights
   7. Automatic Daylight Switching With Occupant Interlock/Override
   8. Status and Runtime Data
2. It shall manage input switches and sensors, output relays as well as lighting sequences and groups, enabling the user to configure and monitor a very large number of different lighting schemes and schedules.
3. Provide for a manual override of each circuit.
4. The SPCC-LC shall provide, as a minimum, the ability to interface with the hardware of the associated relay panels to allow for minimal disruption to the existing high voltage panel wiring. The SPCC-LC shall be capable of providing all logic, control, runtime data, status information, and communications functions.
5. If specified, provide a built-in LCD operator interface with the ability to read the status of the lighting relays and switches and implement temporary override command .
6. The SPCC-LC shall be able to control the General Electric® three-wire relay or a two wire Aromat relay.

PART 4 - BAS SOFTWARE TOOLS

4.1 Provide 5 copies of all tools necessary for the development, maintenance, expansion and use of the BAS described within these specifications. All software

tools shall be a part of the Niagara Framework tools or be provided as Wizards that operates within the Niagara Framework environment. For the purpose of this specification software tools shall be divided into the following categories and meet these specified requirements.

B. Controller Programming Software

1. Provide Wizards or objects that facilitate the programming and configuration of the Configurable Controllers (CC), Programmable Controller (PC) and or the Special Purpose Configurable Controllers (SPCC) sequence of operation through menu driven wizard. The programming tools shall perform the following functions:
    1. PC programming shall be accomplished by graphical programming language (GPL) where objects are used to define different portions of the control sequence. All control sequences programmed into the PC shall be stored in non-volatile memory. Systems that only allow selection of sequences from a library or table are not acceptable. All code must be exportable to a library for future use.
    2. CC and SPCC – Provide for the programming of the required sequence of operation through an intuitive configuration menu driven selection process. The configuration tools menu shall define items such as I/O configurations, set point, delays, PID loops, optimum start stops, and network variables settings. The configuration tool must indicate the device status and allows system override. Graphical programming language as described for the PC is acceptable.

4.2 The Graphical User Interface (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.

A. Provide a visual graphical representation of each piece of mechanical equipment and/or mechanical system that duplicates the represented system, where applicable. Graphics shall include at a minimum the value of each input, each output, each setpoint, alarms and graphical representation of trend logs. The graphic shall provide for the ability to command each point, including both timed and permanent overrides. In addition, provide for all information represented in the graphics in an associated graphical table with links to the equipment graphics and commandable points. All graphics shall commiserate with latest industries

standards and practices. Sample graphics shall be provided as part of the submittals for approval by owner.

B. Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:

1. Graphic screens shall be developed using any drawing package capable of generating or assembling objects from a GIF, 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.

2. 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.

3. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.

   a) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
   b) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.

4. 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. No entry of text shall be required.

5. Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and using a graphical slider to adjust the value. No entry of text shall be required.

C. 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. Select points to be alarm-able and define the alarm state.

7. Select points to be trended over a period of time and initiate the recording of values automatically.

D. On-Line Help. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.

E. 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.

F. 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.

G. Alarm Console

1. The system will be provided with a dedicated 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. The use of the Alarm Console can be enabled or disabled by the system administrator.

2. When the Alarm Console is enabled, a separate alarm notification window 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.

PART 5 - USER INTERFACES

A. Web Browser Clients – shall be capable of total integration of the facility infrastructure systems with user access to all system data either locally over a secure Intranet within the building or by remote access by a standard Web Browser over the Internet. **Systems requiring additional software (to enable a standard Web browser) to be resident on a client machine, or manufacture-specific browsers shall not be acceptable.**

5.1 Provide for a series of browser accessible graphical screens that are resident on the Campus Wide Server that represent the systems controllers and managed by that server and its associated controllers.

A. The Web browser client shall support at a minimum, the following functions:

A. Unlimited concurrent users shall be able to simultaneously login without the need of any additional user licenses or fees.

B. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.

C. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.

D. HTML programming shall not be required to display system graphics or data on a Web page

E. Storage of the graphical screens shall be in the Building Controller (BC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.

F. Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.

G. 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.

A. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.

B. 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. No entry of text shall be required.

C. View logs and charts

D. View and acknowledge alarms

H. 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.

I. 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.

PART 6– PERIPHERAL DEVICES - Use CE standard language

PART 7 - EXECUTION

7.1 INSTRUCTION AND ADJUSTMENTS

Upon completion of the project, the Temperature Control Contractor shall: Check, validate, and calibrate, where required, all controllers, controlled devices, valves, actuators, auxiliary devices, relays, etc. provided under this section.

7.2 COORDINATION

Coordinate the controls furnished under this section with the controls furnished with the boilers and chillers resulting in a complete system properly interfaced.

7.3 SYSTEM TURN OVER

Upon completion of the installation, the Control Contractor shall start-up the system and perform all necessary testing and run diagnostics to ensure proper operation. An acceptance test in the presence of the Owner's Representative, the Architect, or the Engineer shall be preformed. The acceptance test shall consist of a point-to-point check-out within each terminal unit controller to insure proper operation of all system components.

When the system is deemed satisfactory in whole or in part by these observers, the system parts will be accepted for beneficial use and place under warranty.

Problems which occur within approved hardware or software shall be corrected in an appropriate fashion under warranty. Any such occurrence shall not void previous approval; however, the Control Contractor shall be responsible to attend to, and remedy, such items within the warranty period. Appropriate logs, schedules, and reports shall be

maintained to reflect these items and their redress.

7.4 TRAINING/OWNER'S INSTRUCTION

A. The Control Contractor shall provide two (2) copies of an operator's manual describing all operating and routine maintenance service procedures to be used with the system. The Control Contractor shall instruct the owner's designated representative in these procedures during the start-up and test period. The duration of the instruction are to be conducted during normal working hours and shall be no less than sixteen (16) hours divide in (4), four hours sessions.

END OF SECTION 17000

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

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

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

D. Refer to section 230800, Commissioning of HVAC requirements for work related to this section.

1.2 SCOPE OF WORK:

A. Contract includes all labor, material, equipment accessories and test required to furnish and install all air distribution systems as shown on drawings, implied and herein specified, complete and ready to operate.

B. Contractor is requested to examine all of the Architectural plans and all details of construction and visit the site of the proposed addition and alterations so as to thoroughly acquaint himself with all conditions before submitting his bid.

C. Work shall include but is not limited to the following:

1. Ductwork
2. Exhaust Fans
3. Roof top Units

D. Refer to Section 230548 for Seismic Restraints.

E. Contractor shall be responsible for wiring of all temperature controls.

1.3 SUBMITTALS:

A. Refer to Section 200050

B. Submit the following shop drawings.
Ductwork
Fans
Grilles and Diffusers
Fan Dampers
Access Doors
Induction Units

1.4 AIR DISTRIBUTION SYSTEM DESCRIPTION:

A. Furnish and install all supply, return and exhaust air system as indicated on the drawings. Systems to be complete with fans, motors, controls, starters, unless otherwise specifically omitted, ducts, filter banks, registers, grilles, diffusers, vibration eliminating bases, balancing dampers, fire dampers, automatic dampers, acoustical lining, insulation and other accessories to make the system complete and ready to operate to the full intent of the plans and specifications. The capacities and characteristics of fans, air handling equipment, shall be as indicated on the drawings.

B. All ductwork shall be run on warm side of building insulation.

C. Design is based on equipment as described in the drawing equipment schedules. Any changes in foundations, connections, piping, controls, electrical equipment, wiring and connections and openings required by alternate equipment submitted and approved shall be made at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 DUCTWORK:

A. All sheet metal used throughout, except as specifically noted, shall be constructed of galvanized steel sheets as follows:

Rectangular Ducts		Alum.	Copper	
Duct up to 12"		26 ga.	24 ga.	16 oz.
Duct 13" to 30"		24 ga.	22 ga.	24 oz.
Duct 31" to 60"		22 ga.	20 ga.	32 oz.
Duct 60" and beyond	20 ga.			
Casings up to 72"	16 ga.			
Casings beyond 72"	14 ga.			

Bracings for Ducts

Up to 24" None
25" to 40 1" x 1" x 1/8" 4 ft. from joint
41" to 60" 1-1/2" x 1-1/2" x 1/8" 4 ft. from joint
61" to 90" 1-1/2" x 1-1/2" x 1/8" diagonal angles
or 1-1/2" x 1-1/2" x 1/8" angles 2 ft. from joint

B. All fittings, joints, seams and connections shall be made up in accordance with standard recommended practice as described in Air Duct Design, latest ASHRAE Guide and SMACNA Low Pressure Standards, using Class B construction with all seams sealed. Snap lock joints will not be permitted.

2.2 MEDIUM PRESSURE ROUND DUCT:

A. All medium pressure and round ductwork shall be manufactured by the same firm to assure tight fit of all ductwork and components. Provide ductwork in Lindab, North-Eastern Sheetmetal, or Semco.

B. Submit the round duct test data covering leakage rate, bursting strength, collapsing strength, seam strength, and friction loss. Friction loss test data shall cover both the duct and the assembled coupling joints. This friction loss data used in the design of this system, include information on fittings used in system.

C. Round and oval duct shall be manufactured of galvanized steel meeting ASTM A-525 and A-527-67 by the following methods and in the minimum gauges listed:

Diameter	Minimum Gauge	Method of Manufacture
3" thru 14"	24 Ga.	Longitudinal Seam
15" thru 26"	22 Ga.	Longitudinal Seam
27" thru 36"	20 Ga.	Longitudinal Seam
37" thru 50"	20 Ga.	Longitudinal Seam
51" thru 60"	18 Ga.	Longitudinal Seam
61" and Up	16 Ga.	Longitudinal Seam

Longitudinal seam duct shall have a fusion-welded butt seam.

D. Fittings and couplings shall be of the following minimum gauges:

Diameter	Gauge
3" thru 36"	20 Gauge
38" thru 50"	18 Gauge
Over 50"	16 Gauge

1. All fittings are to have continuous welds along seams. All divided flow fittings are to be manufactured as separate fittings, not as tap collars welded into spiral duct sections.
2. All 90 degrees tees and 45 degrees laterals (wyes) up to and including 12" diameter tap size shall have a radiused entrance into the tap, produced by machine or press forming. The entrance shall be free of weld buildup, burrs, or irregularities.
3. Elbows in diameters 3" through 8" shall be two section stamped elbows. All other elbows shall be gored construction with all seams continuous/welded.
4. Where it is necessary to use 2-piece mitered elbows, they shall have turning vanes in accordance with the following schedule.

Diameter	Number of Vanes
3" thru 9"	2
10" thru 14"	3
15" thru 19"	4
20" thru 60"	5
Over 60"	12" Spacing

E. Registers to be mounted directly to duct shall be provided with boots for mounting to round spiral duct.

F. Galvanized areas that have been damaged by welding shall be coated with corrosion resistant aluminum paint.

G. Pipe-to-pipe joints in diameters to 36" shall be by the use of sleeve couplings, reinforced by rolled beads. Use welded angles for 37" diameter and above.

2.3 JOINT SEALING:

A. Round duct joints in diameter through 60" shall be assembled and sealed as follows:

B. Approved sealer is applied to the male end of the couplings and fittings. After the joint is slipped together, sheet metal screws are place 1/2" from the joint bead for mechanical strength. Sealer is applied to the outside of the joint extending 1" on each side of the joint bead and covering the screw heads. Plastic-backed tape is immediately applied over the wet sealer.

C. The duct sealer must be specifically formulated for the job of sealing the field joints for high pressure systems. The sealer shall be compatible with plastic-backed duct tape so the two shall cure and bond together. Samples of sealer and tape and the specification data sheets shall be submitted to the engineer for approval.

D. Flanged joints shall be sealed by Neoprene Rubber gaskets.

2.4 ACCESS DOORS IN DUCTWORK:

A. Furnish hinged and reinforced access doors with wire glass observation port in door in sheet metal work for observation or maintenance of all dampers, controls in sheet metal ducts and housings. This applies to fresh air ducts, exhaust ducts, etc. Furnish doors of tight fitting construction. All duct access doors shall be furnished in Ventlok or equal in Air balance, Advanced Air, Inc. or Louvers & Dampers, Inc.

B. For access doors in architectural finishes refer to Section 200050.

2.5 FIRE DAMPERS:

A. Furnish and install all fire dampers and smoke dampers in Ruskin, Inc. or equal in Air Balance Inc or Controlair, as required by all local and state codes. On all central air supply and exhaust systems, furnish approved fire dampers in accordance with NFPA Bulletin 90A, latest edition, where required by local and state codes.

B. Fire dampers shall possess a 1-1/2 hour dynamic fire protection rating in accordance with UL-555, continuing inspection service and bear the UL label. Fire damper shall be Ruskin Model DIBD2 vertical or horizontal, Style B Curtain type, as noted on plans.

1. The blades are to be interlocking design mounted in a frame having two folded guides that serve as stops. Blades shall be 24GA galvanized steel.
2. The mounting shall be 1-1/2" x 1-1/2" x 18" retaining angles on both sides of partition as per UL test. Sleeves and frame shall be 20GA per UL test.

2.6 VOLUME DAMPERS:

A. Volume dampers with locking quadrants shall be provided on all supply, exhaust and return ducts, on all branches and at all take-off's to registers and diffusers.

B. Dampers shall be constructed of #20 gauge steel properly stiffened and to have locking quadrants outside covering of ducts. Opposed blade multi-lead dampers shall be used wherever damper blade is larger than 12".

2.7 SPLITTERS AND DUCTURNS:

A. Furnish and install splitter dampers in ductwork made of #20 gauge steel for proper control of air, where ductwork branches off from main supply ducts.

B. Refer to "Access Doors" for type of access doors required for access to ceiling dampers.

C. Install ducturns based on Barber Colman non-adjustable 90 degree double wall type in all square elbows.

D. Provide on all branch duct takeoffs as shown in Barber Colman adjustable airturns.

2.8 REGISTERS, GRILLES AND DIFFUSERS:

A. Registers, grilles and ceiling diffusers shall be furnished of size and type as shown on drawings, in Titus and Seiho or equal in Krueger or Metalaire. The cat. no.'s refer to equipment as manufactured by Titus.

B. All registers and wall grilles furnished in steel shall be furnished in prime coat except where specified herein or shown on drawings to be aluminum construction or factory baked enamel.

C. Refer to schedule on drawings for type and finish of each grille.

D. Provide all wall grilles and registers with all purpose frame.

E. All registers and diffusers shall be compatible with ceiling specified under Architectural.

2.9 FAN DRIVES:

A. Furnish each V-belt drive with variable pitch motor pulley unless otherwise specified.

B. Fan manufacturer shall furnish factory standard belt guard for all exposed drives. Field constructed guards will not be approved. Furnish all belt guards with prime coat.

2.10 CANVAS JOINTS:

A. On each side of each centrifugal or centriline fan and at each air handling unit having duct connections, furnish Ventfabric Tape for expansion and elimination of sound travel in ductwork.

B. Furnish and install Doro-Dyne Insuflex, insulated flexible duct connector at all locations where the duct crosses an expansion joint.

PART 3 - EXECUTION

3.1 GENERAL FOR EQUIPMENT:

A. Refer to schedule on drawings for size, type, design capacities and characteristics of fans. Also required accessories shall be indicated in schedule or listed herein.

B. Provide and install all additional structural supports for fans, and air handling equipment, not provided for by the General Contractor.

C. Provide and install vibration eliminators of type and size approved and recommended by the fan manufacturer for the particular application and arrangement of fan installation.

D. Provide and install flexible joints on either side of fan.

E. Furnish all combination disconnect switches and starters for fans unless otherwise called for.

F. This Contractor is responsible for all internal wiring between separate air handling equipment sections.

G. All equipment on base drawings, including roof top units, have been dimensionally coordinated with the architectural and structural drawings. If this Contractor proposes to substitute any equipment other than which is on the basic bid drawings, for review, he shall first verify that the proposed equipment will fit dimensionally.
This Contractor shall be responsible for any additional costs to changes incurred because of the above substitution even after review by the Engineer.

H. Provide service disconnect switches mounted on all rooftop equipment.

3.2 STRUCTURAL SUPPORT:

A. Main dunnage steel shall be provided under another section; however, this Contractor shall provide all supplementary steel for the complete support of equipment.

3.3 DESCRIPTION OF SUPPLY AND RETURN AIR/EXHAUST SYSTEM:

A. Furnish and install the complete horizontal and vertical ducts for each system between all RTU's , ERU's and registers and grilles. For all centrifugal fans, furnish flexible joints either side of fan and extend the fan discharge ducts to wall openings and louvers or other openings as indicated; near wall outlet provide hinged access door with lock for access to damper.

B. Furnish automatic fire dampers with fusible link on all ducts passing through floors or fire walls, and motorize smoke dampers in all ducts passing through smoke partitions and at each such damper, furnish accessible access door.

C. Friction dampers shall be installed in all branch ducts made accessible for adjustment near registers or grilles. For exact type of grilles or registers, refer to drawings.

D. Furnish angle frames to suit construction for all registers and grilles complete with plaster stops.

E. Furnish on each fresh air intake an opposed blade manual damper between louver and motorized damper.

F. Sizes and approximate locations of all ducts are shown on the drawings. Check carefully with the architectural and structural drawings and drawings showing work of other trades to make sure that there will be no conflict between these trades and the ducts.

G. Coordinate the installation of setting frames and registers in order that details as shown on drawings are adhered to. Wood rounds shall be furnished and installed as shown on architectural detail.

H. All ductwork shall be installed as shown on drawings and is to be rigidly braced and supported to prevent vibration and sagging.

I. All hangers and supports are to be fastened securely to concrete, wood or steel construction. Under no circumstances will hangers be inserted supported on suspended ceilings, conduits or pipe be permitted.

J. All vertical ducts shall be supported at each floor level by means of angle iron riveted securely to ducts.

K. Refer to Section 200050 for coordinated drawings.

N. This Contractor is responsible for performing a minimum two-week building flush-out with new filtration media and 100% outside air, after the end of construction and prior to occupancy. Filtration media shall have a Minimum Efficiency Reporting Value (MERV) of 13. When performing the flush-out, the temperature control system shall be operational so that the outside air can be tempered. All coils, fans and filters shall be cleaned before performing testing and balancing. Provide new filter media with a MERV of 13 for all Air Handling Unit Systems, after the flush-out period and prior to occupancy.

L. Contractor shall provide all labor and materials as required to assist the Balancing Contractor in proper balancing of the air systems. Contractor shall return to the job and shall make the necessary adjustments and corrections to the systems as required by the Balancing Contractor in order to achieve satisfactory system performance in accordance with design parameters.

M. This Section shall be responsible for any necessary changes in pulleys and belts required to obtain proper air delivery and shall provide additional dampers, splinters, turning vanes, turbulence vanes and other devices if necessary to obtain the correct system performance, all as directed by the Owner's or its Representative.

END OF SECTION 233113

Model	Qty	Description
RXYQ72TTJU	1	Heat pump VRV-IV (208-230V)
FXFQ18TVJU	2	VRV F (T) - Round Flow Sensing Cassette
FXFQ24TVJU	2	VRV F (T) - Round Flow Sensing Cassette
KHRP26A22T9	2	Refnet branch piping kit
KHRP26A33T9	1	Refnet branch piping kit
BRC1E73	4	new Navigation Remote Controller
BYCQ125B-W1	4	Standard Decoration Panel

Indoor Unit Details

cu-1 - RXYQ72TTJU

Name	FCU	Tmp C	Rq TC	Max TC	Rq SC	Max SC	Tevap	Tmp H	Rq HC	Max HC	Airflow
		°F	BTU/h	BTU/h	BTU/h	BTU/h	°F	°F	BTU/h	BTU/h	cfm
CC-1	FXFQ18TVJU	75.2 / 62.6	n/a	15213	n/a	14055	42.8	68	n/a	20700	742
CC-2	FXFQ18TVJU	75.2 / 62.6	n/a	15213	n/a	14055	42.8	68	n/a	20700	742
CC-3	FXFQ24TVJU	75.2 / 62.6	n/a	20315	n/a	17341	42.8	68	n/a	28014	777
CC-4	FXFQ24TVJU	75.2 / 62.6	n/a	20315	n/a	17341	42.8	68	n/a	28014	777

Name	Sound	PS	MCA	Fuses	WxHxD	Wght
	dBA		A		inch	lbs
CC-1	28-35.5	230V 1ph	0.6	15 A	33.1x9.7x33.1	51
CC-2	28-35.5	230V 1ph	0.6	15 A	33.1x9.7x33.1	51
CC-3	28-36	230V 1ph	0.7	15 A	33.1x9.7x33.1	51
CC-4	28-36	230V 1ph	0.7	15 A	33.1x9.7x33.1	51

Outdoor Unit Details

Name	Model		Comb	Tmp C	CC	Rq CC	Tmp H	HC	Rq HC
			%	°F	BTU/h	BTU/h	°F	BTU/h	BTU/h
cu-1	RXYQ72TTJU		117	89.6	68249	35528	32.0 / 27.0	72808	48714

Name	Model	Piping	Refrigerant		
		ft	Type	Bse Refr	Ex Refr
				lbs	lbs
cu-1	RXYQ72TTJU	24.6	R410A	13	n/a

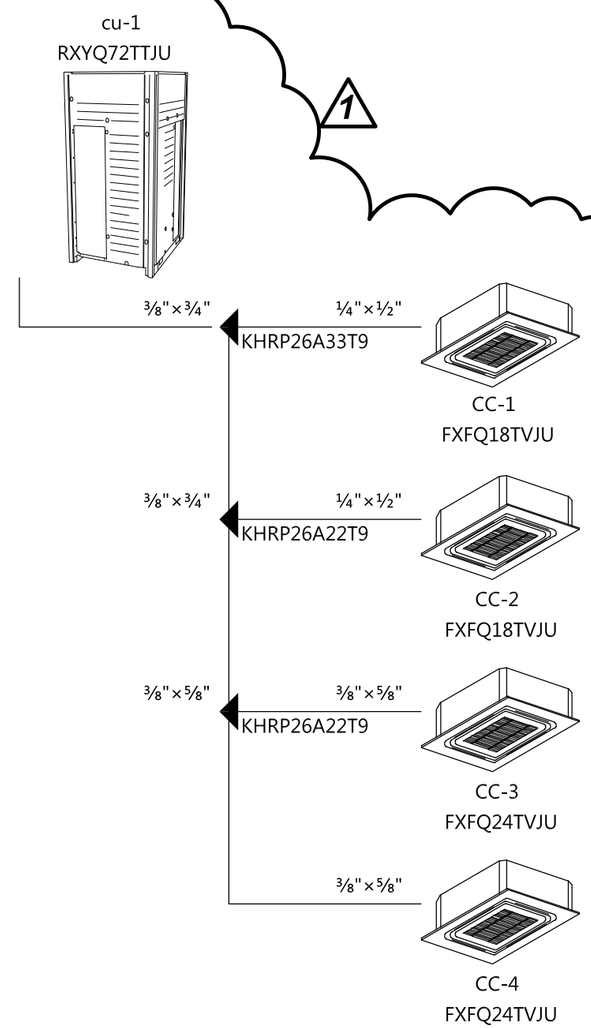
Name	Model	PS	MCA	Fuses	WxHxD	Wght
			A		inch	lbs
cu-1	RXYQ72TTJU	230V 3ph	27.6	35A	36.7x66.7x30.2	437

Name	Ducted				Non-ducted			
	EER	IEER	COP 47°F	COP 17°F	EER	IEER	COP 47°F	COP 17°F
cu-1	13.5	22.8	3.58	2.25	14.1	25.8	4	2.65

Device Options

Indoor Unit Options

Model	Description	Used by
BYCQ125B-W1	Standard Decoration Panel	CC-1 [FXFQ18TVJU] CC-2 [FXFQ18TVJU] CC-3 [FXFQ24TVJU] CC-4 [FXFQ24TVJU]



HEAT PUMP VRV-IV PIPING SCHEMATICS RXYQ72TTJU

NO SCALE

1 ADDENDUM #1

CASIMIR PULASKI ELEMENTARY SCHOOL
NEW AIR CONDITIONING SYSTEM FOR
GYMNASIUM/CAFETERIA AND MEDIA CENTER
MERIDEN, CONNECTICUT

REVISED HEAT PUMP SCHEDULE

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DATE: AUGUST 18, 2016
15-370
DRAWN: RVP
SCALE: NO SCALE

ADD-SKM-1