

SECTION 23 00 00
MECHANICAL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

General Provisions of Contract, including General and Supplementary conditions and General Requirements (if any) apply to work specified in this Section.

1.02 ALTERNATES

There are no alternates that apply to this section of the project.

1.03 DEFINITIONS

ATC Automatic Temperature Control
EC Electrical Contractor (Division 26)
GC General Contractor
HC Heating (mechanical) Contractor (Division 23)
PC Plumbing Contractor (Division 22)

1.04 DESCRIPTION OF WORK

A. Work Included

1. Furnish all labor, materials, equipment, transportation and perform all operations required to install a complete heating, ventilating, heat recovery and air conditioning system in the building, in accordance with these specifications and applicable drawings.
2. All temperatures are expressed in degrees Fahrenheit.
3. Perform demolition and removal as required.
4. Work to be performed shall include, but is not limited to, the following:
 - a. Provide and install direct expansion, air cooled heating and air conditioning (heat pump) systems in building areas indicated on drawings.
 - b. Provide and install forced air ventilating system with heat recovery in building areas indicated on drawings.
 - c. Pipe, valve and fittings
 - d. Insulation
 - e. Fans
 - f. Sheetmetal
 - g. Automatic Temperature Control (ATC)
 - h. Tests and balance

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5. Specifications and accompanying drawings do not indicate every detail of pipe, valves, fittings, hangers, ductwork and equipment necessary for complete installation; but are provided to show general arrangement and extent of work to be performed.
6. Before submitting proposal, Mechanical Contractor shall be familiar with all conditions. Failure to do so does not relieve Mechanical Contractor of responsibility regarding satisfactory installation of the system.
7. Mechanical contractor shall be responsible for rigging to hoist his own (and his sub-contractors) materials and equipment into place.
8. Mechanical contractor and his sub-contractors shall be responsible for start-up of all equipment provided under this section.

B. Related Work Described Elsewhere

1. Cutting and patching
2. Firestopping between building construction and pipe sleeves and between building construction and ductwork, Section 07900.
3. Electrical conduit and wiring, except as noted below
4. Setting of sleeves in masonry work (sleeves provided by Mechanical Contractor)
5. Door louvers
6. All finish work

C. Mechanical Electrical Work

1. Provide and erect all motors, temperature controls, limit switches as specified.
2. Power supply to switches, fused switches, outlets, to line terminals of equipment, and all related wiring and fuses to properly connect and operate all electrical equipment specified shall be furnished and installed under Division 26, "ELECTRICAL". Division 26 shall not mount electrical equipment to indoor mechanical equipment without the consent of Division 23. Division 26 shall not drill wiring holes in equipment casings but shall make use of factory wiring knockouts when present. Coordinate all wiring between Mechanical and Electrical to provide a complete and operating system.
3. All wiring provided under this section shall be in accordance with the latest rules and regulations of the National Fire Underwriters, National Electric code and Local Codes. Install all wiring under the supervision of the Division 26. Any wiring that is not installed according to these standards, and which does not match wiring installed by Division 26 in type, quality and appearance shall be corrected by Division 26 at the expense of this section.

4. Automatic Temperature Control (ATC) Systems

Control wiring shall be furnished and installed by ATC Contractor under supervision of Division 26. Any wiring that is not installed according to these standards, and which does not match wiring installed by Division 26 in type, quality and appearance shall be corrected by Division 26 at the expense of this section.

Low voltage control wiring must be plenum rated and adequately supported with no sags or "droops". Low voltage wiring need not be installed in conduit unless required by local code.

5. Fans

Division 26 to wire line voltage power to wall switch and to unit mounted disconnect switch with overload protection provided with unit.

6. Heat Recovery Unit

Division 26 shall wire line voltage power to unit mounted disconnect switch. Division 26 to also provide line 120 volt power to motor operated dampers associated with heat recovery unit. Dampers and actuators to be provided by ATC Contractor.

7. Air Handlers

Division 26 shall provide and install a service switch for each unit then wire line voltage to service switch and terminals in unit junction box.

8. Outdoor Units

Division 26 shall provide and install a service switch for each unit then wire line voltage to service switch and terminals in unit junction box.

1.05 PERMITS

- A. This Contractor shall be responsible for providing and filing all Plans, Specifications and other documents, pay all requisite fees and secure all permits, inspections and approvals necessary for the legal installation and operation of the systems and/or equipment furnished under this Section of the Specifications.
- B. The Contractor shall frame under glass/ clear plastic all permits, secured by him, adjacent to the respective system and/or equipment and required to be displayed by Code, law or ordinance. Those permits secured but not required to be displayed shall be laminated in plastic and included in the Owner's maintenance manual.

1.06 CODES, ORDINANCES AND PERMITS

- A. All work performed under this Section of the Specifications shall be done in accordance with applicable National, State and local Codes, Laws and Ordinances. The following abbreviations are used for reference to standards which are to be followed:

AABC	Associated Air Balance Council
ADA	Americans With Disabilities Act
AMCA	Air Movement & Control Association
ANSI	American National Standards Institute
ARI	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BOCA	Building Officials and Code Administrators
NEC	National Electrical Code
NFPA	National Fire Protection Association
NEMA	National Electrical Manufacturer's Association
OSHA	Occupational Safety and Health Act
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
UL	Underwriter's Laboratories

- B. The latest issue of each Code in effect at the time of bidding shall be used. Code requirements are the minimum quality and/or performance acceptable. Where the Specifications and/or Drawings indicate more stringent requirements, these requirements shall govern.

1.07 QUALITY ASSURANCE

- A. Mechanical Contractor shall have prior experience with at least two projects of this nature, size and scope and be capable of producing references indicating as such.
- B. Use sufficient qualified workpersons and competent supervisors in execution of this portion of the work to ensure proper and adequate installation of systems throughout. Technical training and certification of workpersons installing the systems specified, by the systems manufacturer, shall be mandatory prior to commencement of work. Documentation of such certification shall be made available to the Architect upon request within 5 business days.
- C. Work performed shall conform with all Local and State Rules and Regulations, as well as those of the International Building Code and National Fire Protection Association (N.F.P.A.).
- D. Piping design shall conform to ANSI, ASME B31.9 and AWS D10.9 codes.

1.08 MATERIALS AND SUBSTITUTIONS

All materials and equipment shall be new and of the latest design of respective manufacturers. **All materials and equipment of the same classification shall be the product of the same manufacturer**, unless specified otherwise.

- A. Any proposal for substitution of Mechanical equipment, materials or vendors shall be made in writing PRIOR TO OPENING OF BIDS. Submit full details for consideration and obtain written approval of the Architect. Allow sufficient time for the Architect to include any approval to submit substitutions in an addendum so all bidders may be made aware. The phrase "or approved equal" shall be defined to mean that the Architect, not the contractor, shall make final determination whether or not substitute materials are an equal to that which is specified. The contractor shall be responsible to certify within his submittals that any equipment to be considered as an "approved equal" meets or exceeds the requirements of this specification in all aspects and will physically fit within the space provided and still provide adequate space adjacent to the equipment for service. If requested by the Architect the contractor shall provide said certification in the form of scale drawings before review will be made. Architect will not be responsible to provide drawings for substituted materials unless the substitution is agreed upon prior to opening of bids. Architect's decision on acceptability of substitute materials shall be final.
- B. Approval by Architect for such substitution shall not relieve Mechanical Contractor from responsibility for a satisfactory installation and shall not affect his guarantee covering all parts of work
- C. Any material or equipment submitted for approval which are arranged differently or is/are of different physical size from that shown or specified shall be accompanied by shop drawings indicating different arrangements of size and method of making the various connections to equipment. Final results will be compatible with system as designed.
- D. Materials and equipment determined as an "approved equal" and/or substitutions must meet the same construction standards, capacities, code compliances, etc. as the equipment (i.e. Manufacturer, model, etc.) specified.
- E. Any additional cost(s) resulting from the substitution of equipment, regardless of acceptance by the Architect or Engineer, shall be paid by this Contractor. Additional costs may include, but not be limited to, electrical and/or structural alterations from the contract documents. Contractor shall be solely responsible to verify that substitutes will fit within the designated spaces provide while permitting adequate clearances for servicing of equipment as required by the manufacturers. Contractor shall, upon request from the Architect or Engineer of record, provide such verification of ample space and clearances in the form of drawings or any other manner requested.
- F. All materials not specified otherwise shall be manufactured within the United States and supplied locally (within the State of Maine) when available. It is preferable to obtain materials that are manufactured within 500 miles of the work site when practical.

1.09 PLANS AND SPECIFICATIONS

Mechanical Contractor shall provide his sub-contractors with a copy of the ENTIRE portion of Part 1 of this specification, portions of this specification and copies of drawings which pertain to the equipment to be supplied at no cost to the sub-contractor. Provide ATC Contractor with entire set of Electrical plans and specifications. Provide Testing and Balancing sub-contractor with copies of shop drawings indicating coil gpm's, air handling unit air volumes, etc. Failure to do so may result in the Architect providing the required materials at the Contractor's expense.

Sketches pertaining to changes and amendments during construction (ASI's, RFI's and RFP's for example) shall be contract form documents issued by the Architect and/or Engineer for use during construction and it shall be the Architect's and/or Engineer's discretion to provide sketches or full size drawings. Requests for documentation other than what is provided (full size revised drawings for instance) and deemed suitable for the particular situation shall be paid for by the contractor making the request. The cost(s) shall include, but not limited to, drafting time and reproduction costs.

1.10 ELECTRONIC DRAWINGS AND FILE SHARING

Plans and specifications may be made available in electronic format on request. Plans may be provided in either Adobe (.pdf) or CAD (.dwg or .dxf) formats and will be compressed using WinZip (.zip format). Recipient is responsible to obtain the necessary software to open the files. Note: CAD (.dwg and .dxf) files will be made available to successful bidders only after a contract is awarded.

CAD drawings are produced with AutoCAD and may be provided in the 2004 or 2010 file format. Upon request for CAD files a release form will be provided which must be signed and returned to the Engineer prior to transmission of electronic files. Physical mailing address, telephone numbers and e-mail address for this office are indicated on each drawing. A signed release will not be required for Adobe based files.

All contract documents are copyrighted material. No portion of materials may be reproduced or duplicated except as indicated in the release form. Where release forms are not required (Adobe based files), materials may be printed for use by the intended recipient only and may not be reproduced or copied in any other manner or for any purpose other than for use pertaining to the construction of this project unless written permission is obtained.

1.11 SHOP DRAWINGS & SUBMITTALS

- A. As soon as possible after award of contract (*but not longer than 21 calendar days*), before any material or equipment is purchased, Mechanical Contractor shall submit shop drawings for review. Unless prior arrangements are made with the Architect all shop drawings must be submitted to the General Contractor who in turn will forward them to the Architect. The quantity of copies shall be as outlined in Division 01. If shop drawings are rejected or returned for re-submittal, Mechanical Contractor shall provide said re-submittals within 14 calendar days of receipt of original submittals with engineer's comments. If original or re-submitted shop drawings are not submitted within the allotted time frames indicated all substitutions included in the late shop drawings will be invalid and the equipment primarily specified must be provided. Any costs resulting from delays in the project schedule due to failure to submit shop drawings related to this section in a timely manner shall be the responsibility of the Mechanical Contractor.

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Mechanical Contractor's and vendor's name, address, telephone & fax numbers and e-mail addresses shall be provided with every shop drawing submission. Capacities indicated are minimums. Equipment submitted with capacities below specified parameters will be refused.

- B. Shop drawings shall be properly identified and shall describe in detail the material and equipment to be provided, including all dimensional data, performance data clearly indicated, fan curves, pump curves, computer selection print-outs, etc. Capacities indicated are minimums. Equipment submitted with capacities below specified parameters will be refused.
- C. Corrections or comments made on the shop drawings do not relieve the contractor from compliance with requirements of the drawings and specifications. Shop drawing review is only for review of general conformance with the design concept of the project and general compliance with the information given in the contract documents. The contractor is responsible for confirming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades and performing his work in a safe and satisfactory manner.
- D. Should any materials or products be purchased and/or installed without prior review and comment the contractor shall be required to remove or replace those products and/or materials, if directed by the Architect, at his expense. If the materials are not removed (or replaced) or if the project is delayed as a result of the contractor's actions, the Architect reserves the right to order the withholding of payment until the situation is resolved in a manner satisfactory to the Architect.
- E. Mechanical shop drawings shall be separate from Plumbing shop drawings. Submittals not separated from plumbing shop drawings will be refused for re-submittal.
- F. Electronic submission of shop drawings is encouraged. Electronic files must be accessible and in an open format, meaning files must not be locked and comments may be added without altering the original content, or have interactive fields intended specifically for commenting. Locked files will not be reviewed. Hard copies of shop drawings must be original documents or good quality photocopies of original documents (photocopies of color samples are not acceptable). Faxed copies of submittal sheets will be refused unless prior arrangements are made.
- G. Review must be obtained on the following items:
 - 1. Ductwork and Accessories
 - a. Registers, diffusers, and grilles
 - b. Duct construction standards
 - c. Volume control dampers (manual and automatic)
 - d. Duct sealant
 - e. Turning vanes
 - f. Bellmouth side takeoff fittings
 - g. Flexible duct
 - h. Louvers and brick vents - provide color chips (photocopies not acceptable) – provide samples if substituting
 - i. Filters

2. Mechanical Equipment (sound data must be provided with all interior motorized equipment).
 - a. Full warrantee information must be included with all submittals.
 - b. Outdoor units and accessories
 - c. Air handling units and accessories
 - d. Equipment identification tags
 - e. Fans and accessories - provide full fan curves and computer selection printouts.
 - f. Heat recovery unit and accessories - provide computer selection printouts.
3. Piping and Accessories
 - a. Refrigerant pipe and fittings
 - b. Condensate drain pipe and fittings
 - c. Pipe supports
 - d. Pipe sleeve wall closure devices
4. Insulation
 - a. Duct
 - b. Equipment
 - c. Pipe
 - d. Pipe fittings
5. Automatic Temperature Control (ATC) System

1.12 PRODUCT HANDLING

A. Protection

Use all means necessary to protect heating, ventilating and air conditioning materials before, during and after installation and to protect the installed work and materials of all other trades.

B. Replacements

In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect at no additional cost to the Owner.

1.13 AS-BUILT DRAWINGS

Keep in good condition at the job, apart from all other prints used in actual construction, one complete set of all blueprints furnished for this job. On this special set of blueprints, record *completely and accurately* all differences between the work as actually installed and the design as shown on the drawings. These record prints must be kept up to date by recording all changes within one week of the time that the changes are authorized. At the completion of the work, this set of drawings shall be delivered to the Architect for the Owner electronically in the form of CAD drawings. If a complete record of changes is not made and electronic CAD drawings not provided by the Mechanical Contractor, a record shall be made by the Engineers, *the cost of the*

record shall be the responsibility of the Mechanical Contractor. Copies of the mechanical CAD drawings (minus professional engineering stamps) may be made available at no cost to the Mechanical Contractor of record if desired. Drawings shall be dated accordingly and clearly identified as "AS-BUILT". See par. 1.09, "ELECTRONIC DRAWINGS AND FILE SHARING" for additional information.

1.14 MAINTENANCE MANUAL

- A. On completion of this portion of the work, and as a condition of its acceptance, submit for approval two copies of a manual describing the system. Mechanical equipment manuals shall be separate from plumbing manuals. All manuals shall be original copies, not photocopies or they will be refused for re-submittal. Prepare manuals in durable 3-ring binders approximately 8½ inches by 11 inches in size with at least the following:
1. Identification on the front cover and spine stating general nature of the manual.
 2. Neatly typewritten index.
 3. Complete instructions regarding operation and maintenance of all equipment involved.
 4. Complete nomenclature of all replaceable parts, their part numbers, current cost, and name, address and telephone number of nearest vendor of parts.
 5. Copy of all guarantees and warranties issued.
 6. Where contents of manuals including manufacturer's catalog pages, clearly indicate the precise item included in this installation and delete, or otherwise clearly indicate, all manufacturers' data with which this installation is not concerned.
- B. In addition to above, provide two (2) separate offset style binders properly identified, each containing a copy of all reviewed shop drawings and catalog cuts. (NOTE: May be incorporated in Maintenance Manuals, if binders are of adequate size.)

1.15 OBJECTIONABLE NOISE AND VIBRATION

Mechanical equipment shall operate without objectionable noise and vibration. Should objectionable noise or vibration be transmitted to any occupied part of the building by apparatus, piping or ducts, as determined by the Architect, the necessary changes eliminating the noise or vibration shall be made by this Mechanical Contractor at no extra cost to the Owner.

1.16 GUARANTEE

This Contractor shall guarantee all materials and workmanship furnished by him or his sub-contractors to be free from all defects for a period of no less than one (1) year from date of final acceptance of completed system and shall make good, repair or replace any defective work which may develop within that time at his own expense and without expense to the Owner. Any additional costs required to extend manufacturer's guarantee and warranty for the period specified, shall be included in Contractor's base bid.

1.17 DEVIATIONS AND DISCREPANCIES

- A. The drawings are intended to indicate only diagrammatically the extent, general character and approximate locations of mechanical work. Work indicated, but having minor details obviously omitted, shall be furnished complete to perform the functions intended without additional cost to the Owner. Follow the architectural, structural, plumbing and electrical drawings so that work under this section is properly installed and coordinated with other Sections.
- B. The drawings and specifications are complimentary to each other and what is called for in one, shall be as binding as if called for by both. In the event of conflicting information on the mechanical drawings, or between drawings and specifications, or between trades, that which is better, best or most stringent shall govern.
- C. Questions to the Architect or Engineers are encouraged, however any answers and/or advice is non-binding unless incorporated into the contract documents in the form of addenda, change order, etc. Inquires requiring an answer prior to opening of bids should be made at least 4 days prior to when bids are due to allow time for a clarifying addendum to be issued.
- D. Any conflicts arising from duplication of equipment specified in different portions of the specifications shall be brought to the attention of the Architect prior to submitting bids. Failure to do so does not relieve the Contractor from responsibility of providing said materials and equipment and a credit will be taken for the duplicated item(s).
- E. Should unforeseen job conditions require re-arrangement of piping and/or ductwork resulting in deviation from the intent of the contract documents or potentially compromising the integrity of the mechanical systems, the Architect shall be notified immediately prior to commencement of work. Failure to do so will result in the contractor being responsible to correct any work installed that is contrary to the contract documents at his own expense.

1.18 CHANGE ORDERS

- A. No change shall be made from the work, equipment, or materials under this section except as directed in writing by Engineer.
- B. All requests for change in contract price and scope shall be accompanied by a breakdown list of materials with unit and extended prices and labor hours with unit and extended price, plus markups that have been applied.

1.19 COORDINATION

- A. Contractor shall be responsible to coordinate his work with that of other trades to adjust to field conditions prior to commencing work. It is also this contractor's responsibility to coordinate locations of his own piping and ductwork to ensure the two do not conflict. If a reasonable solution cannot be achieved without compromising the integrity of the intended design or would result in additional cost the Architect must be notified immediately prior to commencement of work. Failure to do so does not relieve the Contractor from providing and installing the systems to the satisfaction of the Architect at no additional cost.

- B. Contractor shall be responsible to review job conditions and identify conflicts and/or obstructions to ductwork and piping prior to fabrication. If conflicts and/or obstructions are noted the Architect must be notified immediately prior to commencement of work. The cost of any fabrication work performed without confirmation and notification of conflicts and/or obstructions shall be the responsibility of the contractor.

1.20 REQUESTS FOR INFORMATION

Requests for Information (RFI) or other correspondences which are submitted electronically must be in an open format, meaning files must not be locked and comments may be added without altering the original content, or have interactive fields intended specifically for commenting. Locked files will not be accepted.

Requests for design criteria of the mechanical systems must be submitted in the form of an RFI and shall include the purpose for the request.

1.21 WORKPLACE SAFETY

Mechanical contractor shall be responsible for the safety of his workpeople.

PART 2 - PRODUCTS

2.01 PIPING

A. General

Provide and erect in accordance with best practice of trade all refrigerant and drain piping shown on the plans and as required to complete intended installation. Contractor shall make offsets as shown or required to place all piping in proper position to avoid other work, and to allow application of insulation and finish painting.

B. Pipe Materials:

- | | |
|----------------------|------------------------------------|
| 1. Refrigerant | Type "L" hard drawn copper tubing. |
| 2. Condensate drains | Schedule 40 PVC |

C. Pipe Fittings:

- | | |
|----------------|--|
| 1. PVC | Socket fittings with PVC cement |
| 2. Refrigerant | Cast bronze or wrought copper, long radius elbows, made up with Sil-Fos silver solder. |

2.02 INTERIOR HANGERS AND SUPPORTS

A. General

1. All interior hangers and supports shall be specially manufactured for that purpose and shall be the pattern, design and capacity required for the location of use.
2. Piping specified shall not be supported from piping of other trades.
3. Hangers on drain piping shall be sized for the piping only (not including insulation). Hangers on refrigerant piping shall be sized to include the insulation and include thermal hanger shields (insulated pipe supports).

Hangers for refrigerant piping shall be copper or copper plated steel. Carpenter & Paterson, Inc., Fig. 1A CT or approved equal.

Hangers for PVC piping shall be PVC manufactured specifically for PVC pipe or PVC covered steel. Carpenter & Paterson, Inc., Fig. 1A PVC or approved equal.

4. Thermal hanger shields shall be Carpenter & Paterson, Inc., Fig. 265P or approved equal.
5. Exposed vertical risers $\frac{3}{4}$ inch and smaller shall be supported at the mid-point between floor and ceiling.

B. Hanger Rods

1. Hanger rods for metallic hangers shall be all thread rod, galvanized for steel hangers and copper for copper hangers. Rod size shall be as follows:

<u>Pipe Size</u>	<u>Rod Size</u>
1/2" to 2"	3/8"

2. Provide lag points with rod couplings or side beam connectors with drive screws for fastening to wood.
3. All nuts for hanger rod to be stainless steel.

C. Supports

Provide and install angle iron supports for pipe hangers as required. Angle iron supports shall be adequate size for span and piping or equipment load.

2.03 PIPE SLEEVES AND ESCUTCHEONS

A. Interior Sleeves

1. Mechanical Contractor shall set sleeves for all piping penetrating interior concrete and masonry walls and floors. Sleeves shall be schedule 40 steel pipe, two sizes larger than the carrying pipe. Pipes passing through walls and floors of frame construction need not be provided with sleeves.
2. Sleeves set in floors shall finish flush with the underside, but extend a minimum of 1 inch above the finish floor. Sleeves set in walls shall finish flush with each side. General Contractor shall grout between sleeves and surrounding masonry.
3. Spaces between sleeves and pipes shall be sealed fire and smoke tight. Spaces between pipes and floors and between pipes and fire rated walls in frame construction shall also be sealed fire and smoke tight. Sealant material shall be 3M brand fire barrier caulk CP25 or putty 303, Ciba-Geigy CS240 Firestop Sealant, or approved equal and shall be U.L. listed.

B. Exterior Sleeves

Where piping passes through exterior walls, provide and install a complete pipe sleeve/hydrostatic wall closure system as shown on drawings.

1. Wall sleeve shall be schedule 40 steel pipe, two pipe sizes larger than carrier pipe. Sleeve shall be the same length as the thickness of the wall served.
2. The hydrostatic closure device shall consist of identical interlocking links of solid synthetic rubber compounded to resist ozone, water, chemicals and extreme temperature variations. Each link shall be connected by corrosion resistant bolts and nuts to form a belt which is to fit snugly around the pipe. Under each bolt

and nut there shall be a metal pressure plate so that when each nut is tightened the rubber links will expand between the pipe and sleeve to form a continuous, air tight and water tight seal.

3. Units to be Link-Seal system Model LS wall seal by Thunderline Corp. or approved equal.

C. Escutcheons

Where uninsulated piping passes through finish walls, floors, ceilings and partitions, provide and set two piece nickel plated steel floor and ceiling plates. Provide deep type floor plates as required for projecting sleeves. Piping through walls with insulation shall not require escutcheons.

2.04 REFRIGERANT SPECIALTIES

- A. Sight glass and moisture indicator shall be provided in the liquid line at each evaporator coil and at each outdoor unit.
- B. Externally equalized expansion valve shall be installed on each liquid connection to the evaporator coil(s) if not provided by the evaporator manufacturer. Valve size shall be as verified with unit manufacturer based on actual length of piping, quantity of fittings and difference of elevation. Valve shall be manufactured by ALCO or Sporlan and installed in accordance with manufacturer's instructions.
- C. A complete charge of R-410A shall be provided for the system.
- D. The liquid line shall be provided with removable core type filter-dryer and refrigerant valves. Units to be provided with ¼ inch male pipe plug in flange plate for installation of charging valve. Units to be by Sporlan or approved equal.
- E. Suction and liquid refrigerant piping shall be provided and installed. The refrigerant piping shall be run in an approved manner providing traps where necessary to maintain the proper gas velocities and to keep the system free of oil.

2.05 AIR HANDLING UNITS

- A. Furnish and install horizontal, suspended air handling units as indicated on the drawings. Units shall be Trane 4TWB3. Equivalent units by Carrier, McQuay or York will be considered. Capacities shall be as scheduled on drawings.
- B. Units shall be completely factory assembled including evaporator coil, condensate drain pan, fan, motor, filters, electric heating coil and controls in an insulated casing that may be applied in horizontal or vertical configuration. Units shall be air-tight with 4.2 R value insulation and additional sealing systems. Units shall be UL listed.
- C. Evaporator coils shall have a single refrigerant circuit, controlled by a factory installed non-bleed thermal expansion valve. Aluminum fin surface shall be mechanically bonded to 3/8-inch OD copper tubing. Coils shall be factory pressure and leak tested.
- D. Filters shall be included as standard, one-inch low velocity semi-permanent type.

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Provide 3 sets of filters for each unit. One for use during testing and set-up which is to be replaced with a second set once construction is complete and the system is ready to be turned over to the Owner, and the final set to remain in original packaging and stored for the Owner's future use.

- E. Electric heaters shall be factory installed and wired. Control wiring shall be plug-in. Heaters shall fit inside the internal compartment.
- F. Casings shall be of rugged sheet metal and steel frame construction and shall be painted with an enamel finish. Casings shall be insulated and knockouts for electrical power and control wiring.
- G. Fans shall be forward curved, dynamically balanced and statically balanced. Motors shall be 3-speed direct drive and fan motor bearings shall be permanently lubricated.
- H. Controls shall be low voltage. Pig tails, fan contactor, and plug-in module for accessory electric heat control shall be included.
- I. A separate compartment shall be provided in the blower section for the electric heater which shall be field installed. Polarized plugs shall be provided for making electrical connections to the air handler control box from the supplementary heater.
- J. Power supply to unit shall be single point and shall include fan motor and electric heater.

2.06 OUTDOOR UNITS 17, 18, 19 & 20

- A. Furnish and install air cooled outdoor compressor/condensing units as indicated on drawings. Units shall be Trane 4TWB3. Equivalent units by Carrier, McQuay or York will be considered. Capacities shall be as scheduled on drawings.
- B. Units shall be fully charged from the factory for matched indoor section and up to 15 feet of piping. This unit must be designed to operate at outdoor ambient temperatures as high as 150F. Cooling capacities shall be matched with a wide selection of air handlers and furnace coils that are AHRI certified. The unit shall be UL listed. Exterior must be designed for outdoor application.
- C. Casings shall be constructed of heavy gauge, G90 galvanized steel and painted with a weather-resistant powder paint on all louvers, panels, prepaint on all other panels. Corrosion and weatherproof CMBP-G30 DuraTuff base.
- D. Refrigerant controls shall include condenser fan, compressor contactor and high pressure switch. High and low pressure controls shall be inherent to the compressor. A factory installed liquid line drier shall be standard.
- E. Compressors shall feature internal over temperature and pressure protector and total dipped hermetic motor. Other features shall include rotor lock suction and discharge refrigeration connections, centrifugal oil pump, low vibration and noise, anti short cycle timer and crankcase heater.
- F. Condenser coils shall provide low airflow resistance and efficient heat transfer. Coils shall be protected on all four sides by louvered panels.

- G. Provide a factory installed evaporator defrost control to permit operation to 40 F.
- H. Units shall carry a 1 year warranty with compressor warranty extended for 5 years.
- I. Units shall have a single point power supply with factory installed non-fused disconnect switch and factory installed circuit breakers for compressor short circuit protection.

2.07 SERVER ROOM AIR CONDITIONING SYSTEM (OU-21 & AH-223)

- A. Provide and install a split air conditioning system where indicated on drawings. Capacity shall be as indicated. System shall consist of an indoor air conditioning (evaporator) unit and a matched outdoor compressor/condenser unit, all of the same manufacturer.
- B. Air handling unit AH-223 shall be a Mitsubishi Model PKA-A18HA, wall mounted indoor unit with an internal condensate lift mechanism or approved equal.
- C. Compressor/condenser unit OU-21 shall be Mitsubishi Model PUY-A18NHA3 with Model WBPA2 wind baffle for 100% cooling operation down to 0°F. or approved equal.
- D. Control shall be Mitsubishi Model PAR-21MAA wired remote controller or approved equal.

2.08 HEAT RECOVERY UNIT

- A. Provide and install an air to air heat recovery unit as indicated on the drawings. Capacities shall be as scheduled on drawings. Unit shall be Lossnay model LHG-F300RX3-E heat recovery ventilator or approved equal. Unit shall be support individual control using an M-NET DDC control system and shall feature external static pressure settings up 0.65 in. WG, 208/230 Volts, single phase.
- B. Unit shall be factory assembled, wired and run tested.
- C. Unit shall contain be fully self contained with minimal cross (<1% overall) contamination between leaving and entering air streams. Units shall include internal fan, filter section and controls as indicated. The indoor unit fan shall be an assembly with one or two Sirocco fan(s) direct driven by a single motor. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
- D. Filter:

Filter shall be a supplied with the unit. Provide two (2) sets, one to be used during construction and the other set installed when project is completed.
- E. Performance:

Temperature recovery efficiency shall be from 74 to 69% depending on fan speed. Heating enthalpy heat recovery shall be from 67 to 62% depending on fan speed. Sound level shall not exceed 41 dB(A).
- F. Controls

Units shall use controls provided by the manufacturer to perform functions necessary to operate the system. See par. 2.13, "AUTOMATIC TEMPERATURE CONTROLS".

2.09 FANS

A. General

Fans with capacity and types shown on the drawings shall be provided and installed. In order to establish a standard, fan model numbers indicated below are based on Cook. Equivalent units meeting the same standards by Acme, Greenheck and Ilg ONLY will be considered.

B. Types

EF-12 & EF-13 shall be ceiling mounted, direct driven, centrifugal exhaust fan. Basic units shall be not more than 8 inches in height and fit within standard 16 inch joist centers. Cook Gemini Series.

Fan housing shall be constructed of 22 gauge galvanized steel. Motor shall be plug-in, isolated, permanently lubricated. A field wiring compartment with receptacle shall be standard. Blower wheel shall be centrifugal, one piece polypropylene. Grille shall be aluminum construction, white. Duct collar shall be 6 inch diameter and include a backdraft damper.

2.10 SHEETMETAL

A. General

The work under this section includes all the required sheetmetal and duct work, extensions for grilles, manual dampers, setting of control dampers, grilles, registers, diffusers, flexible connections and brick vents as shown on the drawings or required to make the installation complete in accordance with the intent of the drawings and specifications.

B. Ducts

1. The size of ducts marked on the drawings will be adhered to as closely as possible. The right is reserved to vary duct sizes to accommodate structural conditions during the progress of the work without additional cost to the Owners. The duct layout is schematic to indicate size and general arrangement only. All ducts shall be arranged to adjust to "field conditions". The Sheet Metal Contractor shall coordinate his work with Division 16 and other trades.
2. Medium and low pressure ducts shall be constructed of galvanized steel in accordance with the following table of duct sizes OR the latest SMACNA HVAC Duct Construction Standards for Metal and Flexible Duct unless otherwise shown on drawings.

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Low pressure ducts:

<u>Dimensions of Longest Side</u> (inches)	<u>Minimum Sheet</u> <u>Metal Gauge</u>
Up thru 12	26
13 --> 30	24

3. Methods of fabrication and installation shall be in strict accordance with guidelines set forth in the latest SMACNA Guide and Data Book for Low and Medium Pressure Duct Construction unless otherwise shown on drawings. Cross break all ducts with largest dimension being 18 inches and larger. Beaded ducts are not acceptable except for ductwork less than 18 inches in either direction.
4. All dampers and deflectors shall be a minimum of #22 gauge and stiffened as required. Splitter dampers shall not be acceptable.
5. All joints in ducts shall be made air tight, and all branches and turns shall be made with long radius elbows and fittings. Long radius elbows are defined as having a centerline radius of 12 times the width of the duct. If long radius elbows are not used, elbows 18 inches wide and larger shall be provided with fixed double wall airfoil turning vanes designed to reduce the resistance of the elbow to the equivalent of a long radius elbow with a throat radius of not less than duct width. Square elbows less than 18 inches wide shall be provided with single wall turning vanes. Square elbows with outside corners cut at 45° or rounded are not acceptable.
6. All ducts shall be installed with necessary offsets, changes in cross sections, risers, and drops which may be required. They shall be constructed with approved joints and be supported in an approved manner.
7. Round ductwork shall be constructed in accordance with the latest SMACNA HVAC Duct Construction Standards for round and oval duct construction. Ductwork larger than 8 inches in diameter shall employ spiral seams. All turns shall be made with smooth (not segmented), long radius elbows and fittings. All seams shall be type RL-5, grooved seam pipe lock or better. *Lap seams are not permissible*. Gauge thicknesses shall be as outlined in SMACNA for galvanized steel round duct gauge selections for maximum 2 inches w.g. static pressure. Ductwork shall be supported with full wrap-around band and single hanger strap as indicated in Figure 4-4 of the 1985 edition of the SMACNA HVAC Duct Construction Standards handbook.
8. Furnish and install flexible connections on air handlers and heat recovery unit. Connections shall be made from Ventglas neoprene coated glass fabric as furnished by Ventfabrics, Inc., or approved equal.
9. Every precaution shall be taken to keep interior of duct system free from dirt and rubbish and to protect all ducts and equipment during construction. At completion, this Mechanical Contractor shall thoroughly clean all equipment to the satisfaction of the Architect.

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10. Spaces between ducts and wall or floor construction shall be caulked to make smoke and water tight with 3M brand fire barrier caulk CP25 or putty 303, Ciba-Geigy CS240 Firestop Sealant or approved equal.
11. Testing, Balancing and Leak Testing... See Part 3, EXECUTION
12. Requirements set forth in applicable codes (see part one) shall supercede SMACNA standards.

C. Diffusers, Grilles and Registers

1. Grilles and/or registers shall be installed at all air supply, relief, return and exhaust openings as shown. All units to be aluminum, except as noted, and provided with baked enamel finish to match color of grille or register and countersunk screw holes. Mounting screws shall be oval head type with head painted to match finish. Unless stated otherwise, the following list is based on model numbers of Anemostat to establish a standard of quality (if substituting, certified sound criteria shall be included with submittals indicating CFM and NC levels of each register and grille). Krueger, Price and Titus only will also be considered for review.
 - a. Supply Registers: Double deflection; X2HO with opposed blade damper and ¾ inch front blade spacing; front blades set horizontal.
 - b. Supply Grilles: Double deflection; X2H, ¾ inch blade spacing; front blades set horizontal.
 - c. Exhaust and Return Registers: X3HOD with opposed blade damper and ¾ inch, 45° front blade spacing, front blades set horizontal.
 - d. Exhaust, Return and Transfer Grilles: X3HD with ¾ inch, 45° front blade spacing, front blades set horizontal.
2. Diffusers shall be installed at all air supply openings as shown. All units to be aluminum, except as noted, and provided with white baked enamel finish. The following list is based on model numbers of Anemostat to establish a standard of quality (if substituting, certified sound criteria shall be included with submittals indicating CFM and NC levels of each diffuser). Krueger, Price and Titus only will also be considered for review.

Square face, aluminum construction, 2 way discharge with circular duct connection, white finish. Model XDP, pattern 25 with 24x24 inch steel lay-in panel for suspended tile ceilings. Provide model SRA round neck adaptor.

All lay-in diffusers shall be supported to building structure with no less than two (2) safety chains located at opposing corners.

D. Brick Vents

1. Brick vents to be extruded aluminum construction with inside bird screens and anodized finish in color to be selected by the Architect. Provide not less than 2 color chip cards with submittals for review (photocopies not acceptable).
2. All units shall be 8 inches deep and modular in dimension to fit 4 inch standard brick sizes. Units shall be minimum 0.125 inch thick with integral water stop, weep holes and continuous drip edge. Units shall be structurally designed to eliminate need of wall lintels with ¼ inch ribs and full depth headers at 16 inch centers (minimum).
3. Units shall be BVC100 as manufactured by Ruskin or approved equal. Provide sample if substituting.

E. Duct Sleeves

Provide aluminum duct sleeves through outside wall at all locations as shown on drawings.

F. Sealing of Ducts

All ductwork shall be sealed with low VOC water based duct mastic, either "MP" (Multi-Purpose), Hardcast "Iron-grip 601", Polymer Adhesive "Airseal #11", or United Duct Seal (United McGill Corp.) water base, latex or acrylic type sealant. All transverse joints to be continuously sealed. Note that, except as noted, oil or solvent based sealants are specifically prohibited for use on this project. Duct tape is prohibited except on clothes dryer ducts only, use Venture model 3520CW duct tape or approved equal. Ensure duct exterior is thoroughly cleaned prior to installing the tape. Use pop rivets in lieu of screws to fasten dryer duct fittings together.

G. Motor Operated Dampers

Motor operated control dampers mounted in ductwork shall be provided by ATC Contractor, but installed by this Contractor. Contractor shall seal dampers to ductwork to provide a completely waterproof and airtight seal between damper frames and ductwork.

H. Manual Dampers

1. See Part 3, EXECUTION for installation notes.
2. Manual dampers with smallest dimension 5 inches or less shall be shop fabricated, single 22 gauge blade, 3/8 inch rod, provided with position indicator and locking quadrant.
3. Manual dampers with smallest dimension larger than 5 inches but smaller than 11 inches shall be single blade steel, 16 gauge construction, provided with position indicator and locking quadrant. Unit shall be Ruskin Type MD35 or approved equal.

4. Manual dampers with smallest dimension larger than 11 inches shall be opposed blade steel, 16 gauge construction, linkage concealed in frame, provided with position indicator and locking quadrant. Unit shall be Ruskin Type MD35 or approved equal.
5. Dampers to be installed in aluminum ductwork shall be fabricated of aluminum or isolated from ductwork with rubber grommets between the damper and the duct to prevent oxidation between dissimilar metals.
6. Provide hand quadrants for all manual dampers, Ventline Model 560 or approved equal.

I. Flexible Duct

Provide and install insulated flexible duct where shown on drawings. Ducts shall be a double lamination of polyester encapsulating a steel wire helix forming an air-tight inner core. The core shall be wrapped in a blanket of fiberglass insulation (R 4.2) and sheathed in a rugged and durable reinforced metallized polyester jacket. Duct shall be class 1, U.L. 181 compliant and rated for not less than 2 inches w.g. positive working pressure. Duct internal diameter shall be same size as diffuser served. Atco UPC 030 or approved equal.

J. Side Takeoff Fittings (for flexible duct)

Provide and install, at all flexible duct branches to diffusers, a bellmouth side takeoff fitting with manual damper. Fittings shall be pre-manufactured with bell end shall have a 1 inch radius and employ a self-adhesive gasket seal and be pre-drilled for attachment screws. Units with manual dampers shall be heavy duty with bearings and hand quadrants. Fittings shall be anchored to ductwork with not less than three (3) screws. Final diameter shall be same size as diffuser served. Units shall be no thinner than 22 gauge, G-90 galvanized steel. Buckley Bellmouth HD-BM, HD-BMD or approved equal by Flexmaster or United Enertech.

K. Turning Vanes

1. Provide and install at all square duct elbows 18 inches and larger, and where shown on drawings, fixed double wall airfoil type turning vanes. Turning vanes shall be constructed as outlined in the latest SMACNA HVAC Duct Construction Standards guidebook, Figure 2-3.
2. Provide and install at all square duct elbows less than 18 inches in width, and where shown on drawings, fixed single wall turning vanes. Turning vanes shall be constructed as outlined in the latest SMACNA HVAC Duct Construction Standards guidebook, Figure 2-3.

2.11 EQUIPMENT IDENTIFICATION

Tag each new fan, air handling unit, outdoor unit and heat recovery unit with rectangular engraved nameplates with white letters on black, Brady Corp., Seton Name Plate Corp. or approved equals. Nameplates shall be mechanically fastened to equipment (adhesives are not acceptable). Embossed labels are not acceptable.

Nameplates shall be 2½ inches by ¾ inch, Setonply Style No. M1771.

2.12 INSULATION AND CONDENSATE PROTECTION

A. General

1. Insulation shall be provided for all new refrigerant piping, outside air intakes, concealed supply air ducts, exhaust and relief ducts and other insulation where shown on drawings.
2. All insulation products shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less per ASTM E 84, UL 723 and NFPA 255.

B. Refrigerant Piping

1. All refrigerant piping (liquid and gas) shall be insulated with 2 inch flexible, closed cell elastomeric thermal insulation. Material shall be 25/50 rated (flame spread rating of 25 or less and smoke developed rating of 50 or less) when tested in accordance with ASTM E84, latest revision.
2. Piping and fittings exposed to the elements shall have the insulation covered with ultraviolet resistant vinyl outdoor PVC jacket, JohnsManville Zeston 300 or approved equal.
3. Materials shall have a maximum thermal conductivity of 0.27 Btu-in./h-ft²-°F at a 75°F mean temperature when tested in accordance with ASTM C177 or ASTM C 518, latest revisions.
4. Materials shall have a maximum water vapor transmission of 0.08 perm inches when tested in accordance with ASTM E 96, Procedure A, latest revision.
5. Adhesive shall be the insulation manufacturer's recommended contact adhesive: Armaflex 520, Armaflex 520 BLV.
6. Insulation finish shall be the insulation manufacturer's recommended finish: WB Armaflex Finish.
7. Accessories such as adhesives, mastics and cements shall have the same properties as listed above and shall not detract from any of the system ratings as specified above.

C. Duct Insulation

1. Duct insulation shall be a ¾ pound density, all-service fiberglass duct wrap with factory applied foil faced FRK vapor barrier facing meeting the requirements of ASTM C 1136, Type II. Insulation material shall meet the requirements of NFPA 90A, NFPA 90B, ASTM C 1290 and ASTM C 553. Operating temperature range shall be from 40°F. to 250°F. Maximum "k" factor of 0.30 at 75°F. mean temperature difference. Owens Corning Type 75, Johns Manville Microlite XG or approved equal.
2. Insulate air handling unit supply air ducts that are concealed above ceilings with 1½ inches installed thickness fiberglass duct wrap.
3. Insulate the following ducts with 3 inches installed thickness fiberglass duct wrap:
 - a. Heat recovery unit outside air intake ducts from outside wall to unit inlet.
 - b. Heat recovery unit exhaust air duct from outside wall to motorized damper.
 - c. All ductwork associated with EF-1 above the Women's Toilet.
4. Material to carry U. L. label. All laps to be sealed and held in place with adhesive and flare staples. All lap joints to be folded under before stapling so no raw insulation will be showing. On the bottom of ducts 24 inches or wider, mechanical fasteners shall be provided approximately 12 inches O.C.

D. Condensate Protection

Solder or weld bottom and sides of ducts connected to outdoors to prevent water leaks from rain and snow. Seal duct wrap and liner to minimize condensation.

E. Installation

All insulation work shall be executed by skilled insulation workmen regularly employed in the trade.

2.13 AUTOMATIC TEMPERATURE CONTROL (ATC)

A. General

1. Furnish and install a complete system of electric/electronic temperature controls.
2. The control system shall be manufactured and installed by either of the following vendors (listed alphabetically):
 - a. T.A.C.
Maine Controls
400 Presumpscot Street
Portland, Maine 04103
(207) 774-0220

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- b. Honeywell, Inc.
501 County Road
Westbrook, Maine 04092
(207) 775-3501
 - c. Johnson Controls
39 Salem Street
P.O. Box 840
Lynnfield, MA 01940
1-800-288-1028, ext. 4478
 - d. Siemens Building Technologies
66 Mussey Rd.
Scarborough, Me. 04074
(207) 885-4110
 - e. The Trane Company
30 Thomas Drive
Westbrook, Me. 04092
(207) 828-1777
- 3. ATC Contractor must be capable of providing, installing and servicing the control system in its entirety. Sub contracting of parts or partial sections of the ATC system is not permitted. Exception: Sub contracting of ATC wiring is permissible but the ATC contractor shall be ultimately responsible and liable for proper installation as outlined in Divisions 15 and 16 of this specification.
 - 4. The control systems shall be provided and installed by trained control mechanics, regularly employed by the approved vendors, in installation and calibration of ATC equipment. No other vendor will be accepted.
 - 5. Shop drawings of entire control system shall be submitted for approval before work is started.
 - 6. Provide Temperature Control technician to test the complete ATC systems sequences for specified cycles of operation with the Testing and Balancing Contractor.
 - 7. ATC Contractor must, at the end of the warranty period, furnish the Owner with all access codes and passwords assigned to the ATC control systems. ATC Contractor shall also instruct the Owner in the use of all digital control software and provide a backup copy of the final software package to the Owner on CD.

B. Scope

Control system shall consist of all area thermostats, air stream thermostats, valves, dampers, damper operators, relays, transformers, labor, 7day program clocks and other accessory equipment, and a complete system of wiring to fulfill intent of ATC specification. Control shall be provided for, but not limited to the following:

1. Air handling units
2. Outdoor units
3. Heat recovery unit

C. Incidental Work by Others

1. The following incidental work shall be furnished by the designated contractor under the supervision of the Control Contractor.

a. Sheet Metal Contractor shall:

- (1) Install all automatic dampers.
- (2) Provide necessary blank-off plates required to install dampers that are smaller than duct size.
- (3) Assemble multiple section dampers with required interconnecting linkages and extend required number of shafts through duct for external mounting of damper motors.
- (4) Provide access doors or other approved means of access through ducts for service to control equipment.

b. The General Contractor shall:

- (1) Provide all necessary cutting, patching and painting.
- (2) Provide access doors or other approved means of access through ceilings and walls for service to control equipment.

c. Division 26 shall:

- (1) Wire power to all motor operated dampers.

D. Electric Wiring

1. All low voltage and data wiring for installation of temperature controls shall be by ATC Contractor. Power wiring for equipment shall be by Division 26, "ELECTRICAL". See Part 1, Paragraph 1.04, sub-paragraph C, "MECHANICAL ELECTRICAL WORK" for specific requirements.
2. ATC Contractor shall be responsible for coordinating installation of his wiring conduits with Division 26, "ELECTRICAL".

E. Submittal Brochure

The following shall be submitted for approval:

1. Control drawings with detailed wiring diagrams, including bill of material and description of operation for all systems.
2. Panel layouts and name plate lists for all local and central panels.
3. Product data for all control system components.

F. Instruction and Adjustment

Upon completion of the project, the ATC Contractor shall:

1. Adjust for use by Owner, all thermostats, controllers, damper operators, and relays provided under this section.
2. Furnish two (2) instruction manuals covering function and operation of control systems for use of the Owner's operating personnel. A competent technician shall be provided for instruction purposes.
3. ATC Contractor shall be responsible for balancing return air, exhaust (relief) air and outdoor air dampers on air handling units in order to achieve proper mixed air temperatures.

G. Guarantee

Control system shall be guaranteed to be free from original defects in both material and workmanship for a period of not less than one (1) year of normal use and service. This guarantee shall become effective starting the date Architect agrees Owner has begun to receive beneficial use of the system.

H. Hazardous Materials

Mercury, or any other material deemed hazardous by the Federal Environmental Protection Agency or the State of Maine Department of Environmental Protection, shall not be used in any components of the ATC system.

I. Thermostats

1. Air handling unit thermostats shall be electronic and shall include fan control switches to override automatic settings and shall be programmable to include weekday and weekend occupied/unoccupied modes. Thermostats shall include automatic changeover from heating to cooling modes.
2. Thermostats shall be mounted according to ADA requirements (<http://www.access-board.gov/adaag/html/adaag.htm#4.27>).

J. Miscellaneous Devices

Provide all the necessary relays, positioners, transformer, etc. to make a complete and operable system.

K. Motorized Dampers

1. Motorized control dampers shall have 16 gauge galvanized frames not less than 2 inches in width with airfoil blades not less than 14 gauge galvanized steel, and shall be adequately braced to form a rigid assembly. No dampers shall have blades more than 6 inches wide. Dampers shall be painted with one coat of lacquer. Dampers shall be two position or proportioning as required by specific application, opposed blade type with linkage concealed within the frame. Oilite bronze bearings shall be provided at the ends of damper blades
2. Damper operators shall be 120 volt and be provided with bracket arrangement for location outside of air stream wherever possible. All damper motors shall be sufficient size to operate dampers, including slow opening and fast closing.
3. Dampers shall be provided with flexible metal edge and jamb seals and neoprene blade edge seals for tight closure. Leakage shall be certified to be no more than 2.0 CFM per square foot at 1 inch w.g. on units 24 inches wide and larger, 3.0 CFM per square foot at 1 inch w.g. on units less than 24 inches wide.
4. Dampers shall be Ruskin Model CD60, Air Balance Model AC-516, Arrow, or approved equal.

L. Description of Operation

1. Air handling units / outdoor units.

Provide electronic, programmable thermostats to provide programming for occupied/unoccupied periods for each day of the week. Thermostats shall include provision for temperature hold, automatic changeover from heat to cool and fan over-ride.

In the heating occupied mode the air handling unit fan operates continuously. The outdoor unit cycles to provide heat as required by the thermostat setpoint. Provide a sensor in the main supply air duct to monitor discharge temperature. Should the outdoor unit fail to provide discharge temperature of at least 80 degrees F. the unit shall be disabled and the electric heating coil energized to provide heat. In the unoccupied mode the unit fan and outdoor unit shall cycle to provide heat as required.

In the cooling occupied mode the air handling unit fan operates continuously. The outdoor unit cycles to provide cooling as required by the thermostat setpoint. The duct discharge temperature sensor shall be disabled. In the unoccupied mode the unit fan and outdoor unit shall cycle to provide cooling as required.

2. Heat Recovery Unit

Provide the unit with a programmable controller located on the unit. Controller shall provide programming for occupied/unoccupied periods for each day of the week. During occupied periods the unit fans shall operate continuously and off during unoccupied periods. When the unit functions the motorized dampers on the outdoor air intake and exhaust shall be open. Dampers shall be closed when the unit is off.

Provide a sensor in the main supply air duct to monitor discharge temperature. Should the outdoor unit fail to provide discharge temperature of at least 45 degrees F. the unit shall be disabled. Provide an automatic restart feature (with manual override) to start the unit when in the occupied mode 30 minutes (adjustable) after shutdown due to low discharge temperature. Should low discharge temperature continue to shut the unit down after 3 restart attempts and alarm light labeled "Check heat recovery unit" shall illuminate. Locate alarm light in Storage 211 adjacent to the room light switch.

3. Server Room Air Conditioning System

System shall employ internal controls supplied from the equipment manufacturer. ATC Contractor shall install the controls including wiring, mounting of thermostats and verification system is functioning properly.

4. EF-12 & EF-13 shall operate from room light switches by Div. 26.

PART 3 – EXECUTION

3.01 SURFACE CONDITIONS

A. Inspection

1. Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all work is complete to the point where this installation may properly commence.
2. Verify that Mechanical systems may be installed in strict accordance with all pertinent codes and regulations and the approved shop drawings.

B. Discrepancies

1. In the event of discrepancy, immediately notify Architect.
2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 INSTALLATION OF DUCTWORK AND EQUIPMENT

A. General

1. Size and general arrangements as well as methods of connecting all diffusers, registers, grilles, duct coils and equipment shall be as indicated, or to meet requirements for complete installation.
2. Construction standards and sheet metal gauges shall be as outlined in the latest edition of the SMACNA HVAC Duct Construction Standards handbook for metal and flexible ducts unless specifically indicated otherwise.
3. Do not use segmented elbows or screws to connect fittings on clothes dryer ducts. Use smooth, long radius elbows and pop rivets instead.
4. Manual Dampers
 - a. Manual dampers may be shop-fabricated on units 5 inches in height and less. All dampers larger than 5 inches MUST be pre-fabricated as previously outlined in this specification.
 - b. All manual dampers located within 10 feet of a fan outlet shall have the blades oriented perpendicular to the fan shaft.
 - c. Provide duct access door as large as possible up to 12 inches x 12 inches at each manual damper larger than 5 inches.

B. Protection and Cleaning

1. All open ends of ductwork which is to be unattended for 4 hours or more shall be temporarily protected with plastic sheeting and duct tape (or similar method) to reduce the collection of construction dust and debris.

2. Prior to testing and balancing and at the end of the construction, clean the interiors of all supply and return air ductwork before changing filters in air handling equipment. Careful coordination must be maintained between the time of testing and balancing and final delivery to avoid re-accumulation of dust and debris within the duct systems which will require additional cleaning by the Mechanical Contractor.

C. Testing

1. All ductwork shall be tested for leakage prior to installation of insulation and concealment.
2. Leakage test procedures shall follow the outlines and classifications in the latest edition of the SMACNA HVAC Duct Leakage Test manual. See Section 4 of the SMACNA leakage test manual for normal duct classifications.
3. Leakage amount shall not exceed the allotted amount for the pressure class or the allotted amount for that portion of the system, whichever is applicable.
4. Any ductwork which fails to meet the allotted leakage level shall be modified to bring it into compliance and shall retest it until acceptable leakage is demonstrated.
5. At completion of construction, Contractor shall provide written certification, on his company letterhead, indicating that all ductwork has been tested according to specified requirements. Document shall include date of test, test pressures used, leakage class and construction class of each section of ductwork tested.

3.03 TESTING, ADJUSTING AND BALANCING (TAB)

A. General

1. TAB contractor shall be a subcontractor to the Mechanical Contractor.
2. TAB contractor shall perform functional performance test of all Division 23 equipment and entire ATC system for specified operation and control sequences.
3. The mechanical contractor shall startup all Division 23 equipment as required by the equipment specifications. Mechanical contractor shall verify that systems are complete and operable before TAB commencing work. Ensure the following conditions:
 - a. Systems are started and operating in a safe and normal condition.
 - b. Temperature control systems are installed complete and operable.
 - c. Proper thermal overload protection is in place for electrical equipment.
 - d. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - e. Duct systems are clean of debris.
 - f. Fans are rotating correctly.
 - g. Volume dampers are in place and open.
 - h. Air coil fins are cleaned and combed.

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- i. Access doors are closed and duct end caps are in place.
 - j. Air outlets are installed and connected.
 - k. Duct system leakage is minimized.
4. TAB Contractor shall submit field reports to Mechanical Contractor who shall pass them to the General Contractor for submission to the Architect. Report defects and deficiencies noted during performance of services which prevent system testing and balance.
 5. TAB contractor shall submit all verification and functional performance checklists/results, signed by indicated personnel, organized by system and sub-system.
 6. TAB contractor shall submit other reports described below.

B. Work Included

1. Test, adjust and balance all air systems including components to conform to air and flow rates shown on drawings.
2. Test complete automatic temperature control sequences for specified operations described under AUTOMATIC TEMPERATURE CONTROLS.
3. Complete and submit balance report. Report shall be submitted with information noted on one side of sheet only (i.e., backside of sheet shall be blank.).
4. Testing of all systems will be done by the same agency.
5. Mechanical Contractor SHALL PROVIDE copies of shop drawings indicating air handling unit air volumes, etc. to the Testing and Balancing contractor at no cost to the contractor.
6. Careful coordination must be maintained between the time of testing and balancing and final delivery to avoid re-accumulation of dust and debris within the duct systems which will require additional cleaning by the Mechanical Contractor

C. Quality of Compliance

1. Qualification: TAB Contractor must be independent test and balancing agency.
2. AABC Compliance: Comply with AABC Manual MN-1 "AABC National Standards" as applicable to mechanical and hydronic distribution systems and/or Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).
3. Industry Standards: Comply with ASHRAE recommendations for measurements, instruments and testing and balancing.

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4. Coordination: Work together with ATC Contractor to adjust set points of various devices to balance system(s) and test ATC sequences of operation.
5. ASHRAE Guideline 1-1996, "The HVAC Commissioning Process".

D. Execution of TAB Work

1. TAB Contractor shall visit job site and determine that control devices, test devices and valves are correctly installed and ready for balancing.
2. Examine each air distribution system to see that it is free from obstructions. Determine that all dampers and registers are in a set or full open position; that moving equipment is lubricated, and that required filters are clean and functioning. Request that Installing Contractor perform any adjustments necessary for proper functioning of the system.
3. TAB Contractor shall use test instruments that have been calibrated within a time period recommended by the manufacturer, and have been checked for accuracy prior to start of testing, adjusting and balancing activity.
4. Verify that all equipment performs as specified. Adjust variable type drives, volume dampers, control dampers, balancing valves and control valves as required by TAB work.
5. Test pressure profile of systems by traverse as required.
6. Adjust each register, diffuser terminal unit and damper to handle and properly distribute design airflow within 5% of specified quantities. Mark all setpoints.
7. Adjust front and rear discharge louvers on each supply register to distribute air in an even pattern or as indicated on plans.
8. Document results of all testing on approved TAB report formats and submit 3 copies for approval and record within 15 days of completion of TAB work. Include a warranty period of 90 days, during which time the Architect/Engineer may request a re-check or re-adjustment of any part of the work.
9. Reports shall be compiled on a spreadsheet such as Excel, Quattro-Pro, Lotus, etc. and shall clearly indicate the following *minimum* information:

Air (Rated and Actual)

- a. System/unit name
- b. HP, BHP, voltage, amperage and fan rpm
- c. Static pressures
- d. Total system flow rate
- e. Individual terminal flow rates (Terminal readings must show location, make, model and size of register, grille or diffuser).
- f. Provide a static pressure profile of all AHU's components in the two extreme operating modes; minimum outdoor air and economizer cycle.
- g. Filter status report

Reports to have a minimum of color or must be compatible with monochrome printers. Reports must be submitted to the Architect electronically in addition to hard copies.

E. Drawings

Drawings in CAD format may be made available to the TAB Contractor after the contract for this work is awarded. Contact the Engineer via telephone or at remmse@maine.rr.com and request the drawings, indicating CAD format required and a return e-mail address. See par. 1.10, "ELECTRONIC DRAWINGS AND FILE SHARING" for additional information.

F. Acceptable TAB Contractors (listed alphabetically)

1. Central Air Balance
2. Maine Air Balance
3. Tab-Tech International
4. Tekon-Technical Consultants
5. Yankee Balancing

3.04 CLOSING IN UNINSPECTED WORK

A. General

Do not cover up or enclose work until it has been properly and completely inspected and approved.

B. Contractor is required to provide not less than 48 hours advance notice to the Architect of intent to cover non-inspected work.

C. Noncompliance

Should any work be covered up or enclosed prior to all required inspections and approvals, the Architect reserves the right to order the uninspected work to be uncovered for inspection at the Contractor's expense. After the work has been inspected completely and approved, make all repairs and replacements with materials necessary for approval by the Architect and at no additional cost to the Owner.

3.05 TEMPORARY HEATING

A. Mechanical Contractor shall install the new heating system and related equipment as soon as those portions of the building are ready and the work can be performed.

B. Mechanical Contractor will be required to permanently connect as many units as possible for temporary heat.

C. At the conclusion of the temporary heating period, the complete system shall be thoroughly cleaned.

- D. General Contractor will be required to assume full responsibility for the care and operation of the new equipment during its temporary use and to return the equipment to the Mechanical Contractor in perfect order, normal wear and tear excepted.
- E. Water, fuel and electric power required to operate the heating system for temporary heat shall be provided by the General Contractor.

3.06 CLEANING

Prior to acceptance of the buildings, thoroughly clean all exposed portions of the Heating, Ventilating and Air Conditioning installation, including the removal all labels and all traces of foreign substance. Prior to testing and balancing vacuum and clean inside of all convectors, finned radiators (spackle droppings), unit ventilators, air handling units, VAV units, fans and cabinet unit heaters. Clean the interiors of ductwork as outlined in 3.04, "INSTALLATION OF DUCTWORK AND EQUIPMENT"; paragraph "B", "Protection and Cleaning".

3.07 INSTRUCTIONS

On completion of the job, the Mechanical Contractor shall provide a competent technician to thoroughly instruct the Owner's Representative in the care and operation of the system. The total period of instruction shall not exceed twenty-four (24) hours. (Temperature control system instruction shall be in addition to this instruction period). The time of instruction shall be arranged with the Owner.

3.08 REFRIGERANT PIPING

Refrigerant piping shall be installed and tested in accordance to the conditions set forth herein and as required by the manufacturer of the refrigeration equipment by personnel with not less than 5 years experience in the installation of refrigerant piping.

The installation shall be inspected and certified by the manufacturer of the refrigeration equipment prior to charging with refrigerant.

Refrigerant piping shall be run in a approved manner, providing traps where necessary to maintain gas velocities to return oil to the compressor and to keep systems free of oil slugs at the compressor. Fittings shall be long radius and soldered with Sil-Fos or silver solder. The inside of all refrigerant piping shall be thoroughly cleaned using Virginia Solvent #10 or approved equal; followed by a wiping of compressor oil and then wiped dry with a clean, dry cloth. All refrigerant piping shall then be tested with nitrogen and all joints tapped with a rubber mallet to make sure they are tight. A soap solution shall then be applied to each joint. High side test shall be a minimum of 250 psi while the low side test shall be tested to a minimum of 100 psi. Any equipment that may be damaged by these pressures shall be removed. After pressure test, a freon test shall be applied using Halide torch. The interior of the piping system shall be thoroughly cleaned of all oil, dirt and foreign matter then evacuated and dehydrated. All copper tubing shall be supported by copper coated clevis type hangers, see Paragraph 2.03; "HANGERS AND SUPPORTS". The hangers on the suction piping shall be sized to include the insulation and metal shields 12 inches long shall be placed between hangers and insulation.

3.09 RECYCLING

Discarded materials, both new and removed, shall be recycled whenever practical through metal salvage dealers (ductwork, piping, etc.), paper salvage (cardboard shipping containers, etc.), wood & plastic products, etc. The Mechanical Contractor shall retain the salvage value of discarded materials and may use this value to offset his project bid price if so desired. Toxic materials such as adhesives, coolants, refrigerants, etc. SHALL be disposed of in a manner acceptable to the State of Maine Department of Environmental Protection.

3.10 HAZARDOUS MATERIALS

Mercury, asbestos or any other material deemed hazardous by the Federal Environmental Protection Agency or the State of Maine Department of Environmental Protection, shall not be used in any components of the mechanical systems.

END OF SECTION 23 00 00