

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 – This section
EC Electrical Contractor - Division 26
GC General Contractor
HC Heating (mechanical) Contractor - This section
PC Plumbing Contractor - Section 22 00 00

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. Work to be performed shall include, but is not limited to, the following:
 - a. Provide and install forced air heat recovery systems in building areas indicated on drawings.
 - b. Provide and install variable refrigerant flow, direct expansion heat pump systems in building areas indicated on drawings.
 - c. Pipe, valve and fittings
 - d. Air handling units
 - e. Outdoor (compressor/condenser) units.
 - f. Cabinet unit heaters
 - g. Electric heating coils
 - h. Insulation
 - i. Fans
 - j. Sheetmetal
 - k. Automatic Temperature Control (ATC)
 - l. Tests and balance
4. Specifications and accompanying drawings are provided to show general

FIRST & SECOND FLOOR FIT UP PROJECT
MERRILL'S WHARF, PORTLAND, ME

arrangement and extent of work to be performed but do not indicate every detail of pipe, valves, fittings, hangers, ductwork and equipment necessary for complete installation.

5. 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.
6. Mechanical contractor shall be responsible for rigging to hoist his own (and his sub-contractors') materials and equipment into place.
7. 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.
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, motor starters, 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 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

Electric 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.

FIRST & SECOND FLOOR FIT UP PROJECT
MERRILL'S WHARF, PORTLAND, ME

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
 - a. Division 26 to wire to unit mounted disconnect switch with overload protection provided with unit.
 - b. Fans shall operate as indicated on "FAN SCHEDULE", drawing M4 and as indicated in "Automatic Temperature Control" section of this specification.

6. Heat Recovery Units

Division 26 shall provide and wire a disconnect switch for each unit then wire to unit power terminals in factory control box. Additionally, Div. 26 to provide 120 volt power to motor operated dampers associated with each unit. Dampers, actuators and control wiring to be provided by ATC Contractor.

7. Cabinet Unit Heaters

Division 26 shall wire to factory disconnect switch provided with unit.

8. Outdoor (condensing) Units

Division 26 shall provide and wire a disconnect switch for each unit.

9. Air Handlers

Division 26 shall provide and wire a disconnect switch for each unit.

10. Electric Duct Heating Coils

Division 26 shall wire to factory disconnect switch provided with each unit.

1.05 PERMITS

- A. Unless other arrangements are made with the General Contractor, 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 if requested.
- 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 the engineer reserves the right to require only the equipment primarily specified to 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 Contractor. Mechanical Contractor's and

FIRST & SECOND FLOOR FIT UP PROJECT
MERRILL'S WHARF, PORTLAND, ME

vendor's name, address, telephone & fax numbers and e-mail addresses must be provided with every shop drawing submission. Capacities indicated are minimums.

- 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. Incomplete or illegible submittals 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 required. Paper copies will not be reviewed with exception to original copies of color selection samples where required (B&W or grayscale scanned copies of color samples are not acceptable). Electronic files should 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.
- G. Review must be obtained on the following items:
 - 1. Ductwork and Accessories
 - a. Registers, diffusers, and grilles
 - b. Duct access doors
 - c. Volume control dampers (manual and automatic)
 - d. Duct sealant
 - e. Fire dampers and sleeves
 - f. Turning vanes
 - g. Side takeoff fittings
 - h. Flexible duct
 - i. Backdraft dampers
 - j. Manual dampers
 - k. Louvers and brick vents - provide original color samples
 - l. Filters

FIRST & SECOND FLOOR FIT UP PROJECT
MERRILL'S WHARF, PORTLAND, ME

2. Mechanical Equipment (sound data must be provided with all interior motorized equipment).
 - a. Full warrantee information must be included with all submittals.
 - b. Heat pump system including air handlers, outdoor units, branch selectors and all accessories.
 - c. Heat recovery units and accessories - provide computer selection printouts.
 - d. Cabinet unit heater – provide original color samples to the Architect.
 - e. Duct heating coils
 - f. Equipment identification tags
 - g. Fans and accessories
 - h. Electric heating units
3. Piping and Accessories
 - a. Refrigerant piping and accessories
 - b. Drain piping and accessories
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 drawings furnished for this job. On this set of drawings, 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 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, and *the cost of the record shall*

be the responsibility of the Mechanical Contractor. Copies of the mechanical CAD drawings (minus professional engineering stamps) will 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. 1.10, "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

FIRST & SECOND FLOOR FIT UP PROJECT
MERRILL'S WHARF, PORTLAND, ME

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.

FIRST & SECOND FLOOR FIT UP PROJECT
MERRILL'S WHARF, PORTLAND, ME

- 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.

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 hot water supply and return, refrigerant, drain and vent 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 | Type "L" hard drawn copper DWV tubing. PVC not permitted in return air plenums. |

C. Pipe Fittings:

- | | | |
|----|-------------|--|
| 1. | Sweat | Cast bronze or wrought copper made up with 95-5 solder |
| 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. Hangers on refrigerant piping shall be sized to include the insulation and include thermal hanger shields (insulated pipe supports).
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 with split ring type hangers; copper plated for copper tubing. Carpenter & Paterson, Inc., Fig. 81 CT copper plated or approved equal.
6. Attachments to wide flange steel members shall be adjustable beam clamp, Carpenter & Paterson, Inc., Fig. 82 or approved equal.

7. Piping suspended from walls, trench walls and partitions shall be supported by steel support bracket. Carpenter & Paterson, Inc., Fig. 69 or approved equal.

B. Hanger Rods

1. Hanger rods shall be galvanized all thread rod. Rod size shall be as follows:

<u>Pipe Size</u>	<u>Rod Size</u>
½" to 2"	3/8"
2½" to 3½"	1/2"

2. Provide toggle bolts for fastening to concrete blocks and compound anchor shields for bolts for fastening to poured concrete.
3. Provide lag points with rod couplings or side beam connectors with drive screws for fastening to wood.
4. All nuts for hanger rod to be stainless steel.

2.03 PIPE SLEEVES AND ESCUTCHEONS

- A. 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.

B. 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 the evaporator coil and at each compressor-condenser unit if not provided by the equipment manufacturer.
- 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 each system.
- D. The liquid line shall be provided with removable core type filter-dryer and refrigerant valves as shown on the drawings. Units to be provided with ¼ inch male pipe plug in flange plate for installation of charging valve. Units to be Sporlan for refrigerant R-401A 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 CABINET UNIT HEATERS

- A. Cabinet unit heaters shall be provided and installed where shown and fastened securely. The units shall be mounted as indicated on the drawings.
- B. Units shall be as follows:
 - 1. Include multi-blade centrifugal fans with quiet operating high efficiency direct drive motor, insulated casing, coils of copper tubes with aluminum fins, tamper proof access door to motor control switch.
 - 2. Units shall be provided with 3 speed fan switch and unit mounted disconnect switch with thermal overload protection, all factory installed and wired.
 - 3. Cabinets shall be 18-gauge steel with exposed corners and edges rounded, easily removed access panels. Finish shall be factory applied baked enamel in color as selected by Architect on visible surfaces of enclosure or cabinet. Submit two (2) original color chip cards for Architect's review (photocopies not acceptable).
 - 4. Cabinet insulation shall be 2 inch thick dual density bonded glass fiber. Exposed side shall be high density erosion proof material suitable for use in airstreams up to 4500 FPM.
 - 5. Provide two (2) sets of 1 inch *pleated media* throwaway type filters for each unit as specified under paragraph 2.11, "FILTERS". One set to be provided with each unit from the manufacturer to be used during construction and the other set installed when project is completed.
 - 6. Unit shall be vertical configuration, floor mounted. Trane Model BB02 or approved equal by American Air Filter, McQuay or Sterling.

2.06 DUCT HEATING COILS

A. General

Furnish and install duct mounted electric resistance type heating coils where shown on drawings. Capacities and voltage shall be as indicated on Duct Heating Coil Schedule, Sheet M4. Coils shall be designed for slip-in installation.

B. Heaters shall be UL listed under reference E23192 and E53412. Devices shall be suitable for zero clearance to combustible surfaces and for use with heat pump systems. Units shall also incorporate all necessary provisions for installation in full accordance with the National Electric Code.

C. Heater frame shall be heavy gauge corrosion resistant steel. Heating elements shall be constructed of 80% nickel and 20% chromium and supported by ceramic bushings mounted in corrosion resistant steel brackets. Heating elements shall be open coil type.

D. Each heater shall include the following:

1. Integral dustproof control cabinet.
2. Staged electric controls.
3. Manual and automatic reset thermal cutouts.
4. Factory controls wired to clearly marked terminal blocks for field connections.
5. Control transformers.
6. Control relays
7. Door interlocking disconnect switch.
8. Contactors (de-energizing).
9. Air proving switch.
10. Quiet disconnecting contactors.
12. One fuse block per heat stage.

E. Units shall be physically installed in ductwork by the Sheet Metal Contractor with power wiring by Div. 26. Control wiring between heat pump system and coil controls by ATC. Division 26 may be requested to review submittals for NFPA, UL and code compliances.

F. Indeeco model QUA or approved equal.

2.07 HEAT PUMP SYSTEMS

A. General

Provide and install direct expansion, variable refrigerant volume heat pump heating and cooling system with heat recovery capability where shown on drawings. Operation of the system shall permit either individual cooling or heating of each indoor unit simultaneously. Each indoor unit or group of indoor units shall be able to provide set temperature independently via a local remote controller. System capacities shall be as scheduled on sheet M4.

B. Systems shall consist of outdoor compressor/condenser units (Outdoor Units), indoor air handlers (AH) and indoor heat recovery boxes (HR). Systems are designed around LG 3 pipe but approved equivalent systems utilizing 2 pipes and central refrigerant distribution devices will be considered. If substituting, contractor (or manufacturer) must submit a

FIRST & SECOND FLOOR FIT UP PROJECT
MERRILL'S WHARF, PORTLAND, ME

full set of drawings showing every detail of the system and locations of air handling units and refrigerant distribution devices. CAD drawings of the building floor plans may be made available if desired, see par. 1.10, "ELECTRONIC DRAWINGS AND FILE SHARING" for further details. Submittals missing the required information will be refused.

C. Qualifications

The systems must be installed by factory trained contractors/dealers. Bidders shall be required to submit training certification proof with bid documents. The mechanical contractor's installation price shall be based on the systems installation requirements. The mechanical contractor bids with complete knowledge of the mechanical system requirements.

D. Performance Conditions

1. Each system shall be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.
2. Cooling: indoor temp. of 80°F DB, 67°F WB and outdoor temp. of 95°F DB.
3. Heating: indoor temp. of 70°F DB and outdoor temp. of 47°F DB, 43°F WB.
4. Equivalent piping length: 25ft
5. System EER and COP values shall be certified to AHRI Std. 1230 Standard for Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air Conditioning and Heat Pump Equipment. Units shall be tested by a Nationally Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995/CAN/CSA-C22.2 No. 236-05 (R2009) – Heating and Cooling Equipment and bear the Listed Mark.
6. The operating range in cooling shall be (-4°F) 23°F DB ~ 122°F DB. Each system as standard shall be capable of on-site reprogramming to allow low ambient cooling operation to -4°F DB.
7. The operating range in heating shall be 0°F DB – 77°F DB / -4°F WB – 60°F WB. Simultaneous cooling/heating operating range shall be (-4°F) 23°F WB ~ 60°F WB.
8. Cooling mode indoor room temperature range shall be 57°F-77°F WB.
9. Heating mode indoor room temperature range shall be 59°F-80°F DB.
10. Each system shall be capable of refrigerant piping up to 540 actual feet or 620 equivalent feet from the condensing unit to the furthest indoor unit, a total combined liquid line length of 3,280 feet of piping between the condensing and indoor units with 295 feet maximum vertical difference, without any oil traps. Factory approved piping joints and headers shall be used to ensure proper refrigerant balance and flow for optimum system capacity and performance. T style joints shall not be acceptable.

E. Standards and Warranty

1. Units shall meet ANSI/AHRI Standard 1230 2010 Standard for Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air Conditioning and Heat Pump Equipment. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995 – Heating and Cooling Equipment and bear the Listed Mark.

FIRST & SECOND FLOOR FIT UP PROJECT
MERRILL'S WHARF, PORTLAND, ME

2. All wiring shall be in accordance with the National Electric Code (NEC).
3. The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.
4. Mechanical equipment for wind-born debris regions shall be designed in accordance with ASCE 7-2002 and installed to resist the wind pressures on the equipment and the supports.
5. Units shall be factory charged with R-410A.
6. Units shall be warranted to the customer who is the original owner and user of the products that under normal use and maintenance for comfort cooling and conditioning applications such products (the "Products") will be free from defects in material or workmanship. Warranty shall apply to parts only and is limited in duration to one (1) year from the earlier to occur of (a) the date of original installation, whether or not actual use begins on that date, or (b) eighteen (18) months from the date of shipment by Daikin AC. Repaired or replacement parts are warranted for the balance of the warranty period applicable to the original part following the date on which the repaired or replacement part is provided to the Customer. This warranty shall be extended to a six (6) year period on the compressors.

F. Outdoor Units

1. Outdoor unit casing shall be constructed of 22-gauge heavy duty steel. An easily removable front panel shall be provided to allow access to major components and control devices. Casing shall be supplied with lifting handles in four locations and a unit base rail with built in lifting channels designed to accommodate a standard forklift.
2. Exterior surfaces shall be cleaned, and finished with weather resistant baked enamel finish applied using a powder-coat process. The outdoor unit coil and condenser fan openings shall be protected with heavy gauge steel wire guards finished with a baked enamel finish applied using a powder coat process.
3. The unit casing shall be designed to allow for easy access to all unit components from the front of the unit. The unit shall have a single service access panel that when removed allows easy access to all serviceable components. Access to the unit's main printed circuit board, three-digit LED display, fourteen binary switches, auto addressing button, and service tool connection point shall be accessible without removing the main service panel. When the circuit board access panel is removed, the panel shall be secured to the unit casing via a lanyard.
4. Electrical components shall be mounted in weather-proof enclosures mounted on heavy duty hinges designed to swing the panel out of the way for easy access to unit components located behind the panels. Electrical panels' hinges shall be a lift-off design so that panel(s) can be removed from the unit frame without the use of tools or removing hinge pins. Quick connect plugs shall be provided in all wiring to and from the electrical panels for easy panel removal without requiring the removal of components from the electrical panels
5. Outdoor unit noise shall be attenuated so the sound level rating does not exceed 58.0 ±3dB(A) per chassis at nominal operating conditions measured at a position 3.3 feet away from and 3.3 feet above the outdoor unit mounting surface.

FIRST & SECOND FLOOR FIT UP PROJECT
MERRILL'S WHARF, PORTLAND, ME

6. All compressor motors shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10% of nameplate voltage. All compressors shall be equipped with a crankcase heater, internal temperature, and current sensing motor overloads. External suction and discharge temperature sensors shall be provided to protect each compressor from damage caused by over temperature or over pressure conditions. Compressor bearing shall be provided with a Teflon® coating on all wear surfaces.
7. Scroll type compressors shall provide inherently low vibration and noise by having no suction and discharge reed valves. The compressor compartment shall be lined with sound attenuating insulation and mounted on isolation pads to avoid transmission of mechanical vibration. Compressors shall be mounted on rubber grommets to prevent any compressor vibration from transmitting to the unit case.
8. Each chassis shall be provided with factory installed components including a refrigeration filter, check valves, oil separator(s), accumulator, hot gas bypass valve, four-way reversing valve, electronic expansion valve (EEV), high and low side charging ports, and interconnecting piping.
9. Each chassis shall be equipped with an integral subcooling circuit consisting of a plate-type heat exchanger and an electronically controlled thermal expansion valve (EEV) capable of providing enough subcooling to properly operate the system with field installed refrigeration pipe system designed with the following limitations:
 - a) The connected refrigerant piping network's equivalent length shall not exceed 3,280 feet.
 - b) The longest distance between the outdoor unit and the farthest indoor unit shall be not less than 738 feet.
 - c) The maximum elevation distance between any two indoor and/or heat recovery units shall be not less than 49 feet.
 - d) The maximum distance from the first Y-branch fitting to the farthest indoor unit shall not exceed 295 equivalent feet.
 - e) The refrigeration circuit shall be designed to properly operate with an elevation difference of 328 feet between any indoor unit and the outdoor unit without regard to the outdoor unit location being above or below the indoor units.
10. Each outdoor unit chassis shall have two compressors. Dual chassis units shall have a minimum of four compressors. Triple chassis units shall have a minimum of six compressors.
11. For each chassis provided, one compressor shall be inverted driven and the second shall be a constant speed design.
12. The inverter driven compressor shall be a hermetically sealed, single rotor, scroll type specifically designed for the refrigerant R-410a. Inverter driven compressors shall be designed and built by the unit manufacturer.
13. The compressor frequency inverter shall be digitally controlled (DC). Analog controlled (AC) inverter designs are not acceptable. The inverter shall be designed and manufactured by the outdoor unit manufacturer and be capable of modulation range from 25 to 105Hz.

FIRST & SECOND FLOOR FIT UP PROJECT
MERRILL'S WHARF, PORTLAND, ME

14. Compressor bearing shall be provided with a Teflon® coating on all wear surfaces. Inverter driven compressors shall be provided with a trochoid type oil pump capable of providing a sufficient oil film on all bearing surfaces across the entire inverter modulation range. Oil provided to the upper bearing shall be distributed to the bearing surfaces using a positive displacement injection mechanism.
15. The constant speed compressor shall be a hermetically sealed, single rotor type and operate at 60 Hz. Compressors shall be designed and made by the unit manufacturer. The compressor scroll shall be a high efficiency design specifically engineered around refrigerant R410a.
16. Compressor bearings shall be provided with a Teflon® coating on all wear surfaces. Constant speed compressors shall be provided with a centrifugal type oil pump capable of providing a sufficient bearing oil film on all bearing surfaces at all times.
17. Refrigeration oil levels in the compressor crankcase shall be maintained using a three stage oil control system. The compressor discharge port shall be designed to minimize oil loss from the compressor. The high pressure discharge vapor shall leave the compressor and immediately enter an oil separator that uses centrifugal force to extract oil from the refrigerant gas stream. The outdoor unit microprocessor shall be equipped with a control algorithm designed to control the position of electronic expansion valves located in the indoor units. The algorithm shall monitor the amount of time the compressor has run. For every indoor unit that is not running, the algorithm shall open the valve and allow refrigerant flow for a minimum of three minutes to flush any trapped oil back to the outdoor unit.
18. Outdoor unit coils shall be two rows and manufactured using non-ferrous materials. Tubes shall be copper. Fin material shall be aluminum with a stamped louvered configuration. Fin material shall be finished with a factory applied *Gold-Fin™* corrosion resistant finish complete with a hydrophilic coating prior to coil assembly. Coil coating shall be tested using ASTM B-117 salt spray test procedure to 1000 hours. Coils shall be burst tested at a 600 psig.
19. Outdoor units shall be furnished with two direct-drive propeller type fans per chassis designed for low noise discharge out of the top. Optionally the manufacturer shall be able to provide fan discharge air guides design to convert the discharge airflow direction from vertical to horizontal. Fan blades shall be 20-1/2" statically and dynamically balanced propeller fans made of durable Lupos (ABS) polymer resin.
20. Fan motors shall be a designed and built by the unit manufacturer. The motor shall be a brushless digitally controlled (DC) design and have permanently lubricated ball bearings designed for a minimum life of 30,000 hours. Motor windings shall be provided with inherent overload and over temperature protection sensors. Motors shall be designed to operate at a maximum speed of 950 rpm to assure quiet operation.

FIRST & SECOND FLOOR FIT UP PROJECT
MERRILL'S WHARF, PORTLAND, ME

21. Fan speed shall be controlled using a microprocessor control algorithm that modulates the fan speed between three pre-programmed field adjustable speeds. Analog controlled (AC) inverters are not acceptable.
- a) Fans control algorithm shall provide a night-time (off peak) fan speed limiting control that reduces unattenuated noise per chassis to one of three steps (47dB(A), 44 dB(A), and 41 dB(A)). The controller shall be designed to provide the technician a choice between three field-selectable off-peak operation schedules.
 - b) Outdoor units shall be factory wired with necessary electronic control components, printed circuit boards, thermistors, sensors, terminal blocks and contactor lugs for power wiring. Control wiring circuit shall be 24-volt which includes control power transformer and fuses. Microprocessor based algorithms and sensors shall provide outdoor unit component protection, soft-start capability, refrigeration system pressure and temperature control, defrost and low ambient controls. Unit shall be designed for continuous operation from -4° F to 61°F in heating mode and 21° F to 110°F without providing field installed low and/or high ambient head pressure controls.
 - c) The microprocessor shall have an algorithm designed to adjust the outdoor unit fan speed for installations using a field supplied snow hood, hail guards, or installations requiring a ducted supply, and/or discharge air plenum. The setting shall be field selectable for 0.00", 0.08" or 0.16" wg external static pressure.
 - d) While operating in the heating mode, the outdoor unit shall have an automatic defrost control cycle designed to cycle the compressor operation based on indoor unit low pressure vapor pipe temperature.
 - e) When the system is started, the connected indoor units shall be assigned an electronic unit address automatically by the outdoor unit microprocessor.
 - f) The microprocessor shall have a refrigeration system pump-down cycle that will isolate up to 17.6 pounds of the systems refrigerant charge into the outdoor unit coil per chassis. The unit shall be equipped with back-seat valves that isolate 17.6 pounds of the charge in the outdoor unit chassis refrigeration circuit.
 - g) The microprocessor shall have a refrigeration system pump-out cycle designed to evacuate the majority of the system refrigerant charge from the outdoor unit. The unit shall be equipped with factory installed back-seat valves used to isolate the outdoor unit from the balance of the refrigeration system.
 - h) The microprocessor shall have a cooperative control algorithm that automatically adjusts distribution of refrigerant in the system to prevent any one indoor unit from being starved for refrigerant.
 - i) Upon unit malfunction, power outage, or system shutdown, the microprocessor shall store up to three minutes of data history into non-volatile EEPROM memory for troubleshooting.

FIRST & SECOND FLOOR FIT UP PROJECT
MERRILL'S WHARF, PORTLAND, ME

- j) The active system malfunction codes shall be communicated using a three-digit, seven-segment display on the main microprocessor board. The microprocessor actively verifies the operational condition of system sensors.
- k) The microprocessor shall have an algorithm that continually verifies the refrigerant system charge is correct. The servicer shall be able to verify proper refrigerant charge.

G. Heat Recovery (HR) Units

- 1. Heat recovery units shall be designed and made by the VRF unit manufacturer. Units shall be completely factory assembled and provided with solenoid valves, serviceable valve solenoid coils, microprocessor controller, and brazed interconnecting piping. Units shall be factory pressure tested at 600 psig and ship with a dry nitrogen charge.
- 2. Units shall be designed so multiple heat recovery units can be piped in series or in parallel relative to each other. Heat recovery units shall be provided with a maximum of 4 indoor unit piping ports and a combined connected indoor unit capacity of 160 MBh. Each heat recovery unit port shall be designed to provide a maximum capacity of 48 MBh. Multiple indoor unit ports may be piped together using inverted Y-branch fittings made by the VRF equipment unit manufacturer to accommodate indoor units with capacities exceeding 48 MBh.
- 3. All heat recovery boxes shall operate using 208-230/60/1 power with a utilization range of plus or minus 10% of nameplate voltage.
- 4. Heat recovery unit casing shall be galvanized steel. A removable top access service panel shall be provided for easy access to port solenoid coils and a side panel to access the microprocessor circuit board components. The serviceable component area of the heat recovery box(s) shall be isolated from the lower section containing the refrigeration piping, heat exchangers, and solenoid valve bodies with a galvanized metal divider.
- 5. The section containing the refrigerant piping, heat exchanger(s), and solenoid valve bodies shall be filled with insulating material so that no condensation forms on any cold surfaces.
- 6. Each indoor unit port shall have a fully independent metallic spiral tube heat exchanger and three two-position control valves to direct refrigerant flow through the unit.
- 7. The heat recovery unit(s) shall be designed so that condensate drain lines are not required.

H. Air Handling Units

- 1. Air handling units shall be quiet operating, ducted, high static models made by the same manufacturer as the outdoor unit. Air handling units shall be factory assembled, wired, piped, and provided with an internal electronic expansion device, control circuit board, fan and motor. The air handling unit electrical power shall be 208/230V, 1-phase, 60 Hz. Units shall be capable of satisfactory operation within voltage limits of +/-10%.

FIRST & SECOND FLOOR FIT UP PROJECT
MERRILL'S WHARF, PORTLAND, ME

2. Air handling unit refrigeration circuits shall be pressure tested at the factory and shipped with a holding charge of dry nitrogen gas.
3. All internal refrigerant lines are factory insulated. All refrigerant lines external to the indoor unit case shall be field insulated. The entire unit shall be run tested at the factory.
4. Units shall be provided with a factory installed non-metallic condensate drain pan. An insulated flexible condensate drain hose shall be provided to connect the unit drain pan to the field provided condensate drain system.
5. Air handling unit coils shall be a minimum of two rows and manufactured using non-ferrous materials. Tubes shall be copper with inner grooves. Fin material shall be aluminum with a stamped louvered configuration. Coils shall be factory pressure tested to 600 psig air pressure.
6. Units shall be provided with 45° flare refrigerant pipe connections.
7. Casings shall be designed to mount concealed inside a ceiling cavity. Discharge shall be front horizontal with a dedicated rear horizontal return. The unit shall be manufactured using heavy-gauge galvanized steel. The cold surface areas of the case shall be covered with sheet insulation made of high density ethylene propylene diene M-class rubber (EPDM) manufactured per ASTM standard D-1418. The case shall be provided with metal hangers designed to support the unit weight on four corners. Hangers shall have pre-punched holes designed to accept field supplied all thread rod hangers. Casings shall be designed to provide front side discharge and rear side return
8. Units shall be equipped with two sirocco fan wheels made of high strength ABS GP-2200 polymer resin. Both fans wheels shall be directly driven and mounted on a common shaft. The fan assembly shall be statically and dynamically balanced across the entire operating speed range.
9. Fan motors shall be high efficiency, brushless, digitally controlled (DC), having permanently lubricated ball bearings tested for a minimum life cycle of 30,000 hours designed and made by the unit manufacturer.
10. Fan assembly speed shall be adjustable from zero to full speed using a microprocessor based direct digital control algorithm that provides a minimum of three pre-programmed fan speeds.
11. Return air shall be filtered with a removable, washable filter designed to capture airborne dust particles. Filter media shall be treated with an anti-fungal agent to restrict the growth of bacteria on the media.
12. Each unit shall be provided with a microprocessor based controller made by the unit manufacturer designed to perform all functions necessary to operate the system and shall interface with the outdoor unit and other indoor connected devices via a RS485 daisy chain communications link.
 - a) The microprocessor control algorithms shall provide self-diagnostics, auto restart following power restoration, and test run functions.
 - b) The microprocessor control algorithm shall provide five operation modes: Auto Operation, Heating, Cooling, Dehumidification, and Fan Only. Auto Operation mode shall automatically switch between cooling, dehumidification, and heating based on room temperature conditions.
 - c) In the heating mode, the microprocessor control shall not begin fan operation until the coil has reached 78°F.

FIRST & SECOND FLOOR FIT UP PROJECT
MERRILL'S WHARF, PORTLAND, ME

- d) The microprocessor control shall provide a method for the service technician to adjust the delivered air volume at each preset fan speed to compensate for restrictions to airflow (ESP).
 - e) Each unit shall be equipped with a room temperature thermistor mounted in the return air stream. Wall mounted controllers shall be equipped with a temperature thermistor.
 - f) Each unit shall be designed to work with a wall mounted remote temperature sensor. Units shall be capable of controlling operations using any of the three sensors individually or any two of the three concurrently.
 - g) The microprocessor control shall provide malfunction diagnostic codes at the local controller upon unit malfunction. Displayed diagnostic codes shall be specific and provide the service technician with the source of the malfunction.
13. Units shall be provided with a factory installed and wired condensate lift pump capable of providing a minimum 27½ inches lift from the bottom exterior surface of the unit casing.
14. Unit drain pan shall have an auxiliary drain pan connection provided with a rubber stopper that when removed allows the pan to be drained for service via gravity.

I. Field Supplied Items

- 1. All refrigerant lines from the outdoor unit to the heat recovery unit and from the heat recovery unit to the indoor units shall be field insulated.
- 2. All refrigerant piping runs shall not exceed the specifications set forth by the manufacturer for each model. All field provided piping shall be installed in accordance with the restrictions and guidelines provided by the manufacturer.
- 3. Provide field supplied full port isolation ball valves on the inlet and the outlet piping connections.
- 4. All refrigerant piping, liquid and suction lines, including ball valves, Y-Branches, headers and other refrigerant fittings external to the indoor or outdoor unit case(s) shall be field insulated. See par. 2.14, "INSULATION AND CONDENSATE PROTECTION".
- 5. Field provided power wiring and components shall be sized in accordance with the unit manufacturer's recommendations, NEC code, local code - whichever is most restrictive. Indoor unit power may be sourced from terminals provided by the manufacturer in the outdoor unit, or optionally, from a separate electrical panel.
- 6. Field provided control wiring shall be sized in accordance with the unit manufacturer's recommendations, NEC code, or local code - whichever is most restrictive. Control wiring shall be 24-volt RS485 two conductor stranded shielded twisted pair wire routed in a daisy chain configuration between the outdoor unit(s), heat recovery units, indoor units, and central control devices. No star or home run configurations allowed.

J. Warranty

1. Outdoor unit: Manufacturer shall provide 2-year parts only warranty and an extended 4-year parts only warranty on all hermetic compressor assemblies. Warranty period shall commence on the date of original installation or 60 days from the date of shipment whichever is sooner.
2. Air handling and heat recovery units: Manufacturer shall provide a 2-year parts only warranty. Warranty period shall commence on the date of original installation or 60 days from the date of shipment whichever is sooner.

K. Manufacturer

Entire system shall be of one manufacturer, LG Multi-V Sync-II Variable Refrigerant Flow Heat Pump System or approved equal by Daikin or Mitsubishi.

2.08 HEAT RECOVERY UNITS

- A. Units shall be of the same manufacturer, Lossnay model LHG-F470RX3-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 0.80 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. 2.15, "AUTOMATIC TEMPERTURE CONTROLS".

2.09 FANS

A. General

1. 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 (unless noted otherwise) Equivalent units by Acme, Greenheck and Ilg ONLY will be considered.
2. Fan shall bear the AMCA Certified Ratings Seal for sound and air performance and shall be listed by the Canadian Standards Association Testing Laboratory (CSA). Sones indicated on drawings are AMCA ratings and are the maximum allowable. HVI sound ratings are not acceptable.

B. Types

1. EF-14 shall be ceiling mounted, direct driven, centrifugal exhaust fan, Model GC 120-180.
2. Fan shall be manufactured at an ISO 9001 certified facility. Fan shall be listed by Underwriters Laboratories (UL 705) and UL listed for Canada (cUL 705). Fan shall bear the AMCA certified ratings seal for sound and air performance.
3. Wheel housing and integral outlet duct shall be injection molded from a specially engineered resin exceeding UL requirements for smoke and heat generation. The outlet duct shall have provision for an aluminum backdraft damper with continuous aluminum hinge rod. The inlet box shall be minimum 22 gauge galvanized steel. Motor shall be isolation mounted to a one piece galvanized stamped steel integral motor mount/inlet. A field wiring compartment with receptacle shall be standard. To accommodate different ceiling thickness, an adjustable prepunched mounting bracket shall be provided. Unit shall be shipped in ISTA certified transit tested packaging.
4. Wheel shall be centrifugal forward curved type, injection molded of polypropylene resin. Wheel shall be balanced in accordance with AMCA Standard 204-96, *Balance Quality and Vibration Levels for Fans*.
5. Motor shall be open drip proof type with permanently lubricated sealed bearings and include impedance or thermal overload protection. Motor shall be furnished at the specified voltage and phase.

Furnish fan with the following accessories:

- a. Internal, factory wired speed controller.
- b. White aluminum grille.

2.10 SHEETMETAL

A. General

The work under this section includes all the required sheetmetal and duct work, extensions for grilles, manual dampers, automatic counterbalanced (backdraft) dampers, deflectors, setting of control dampers, grilles, registers, diffusers, flexible connections, fire dampers, and louvers, 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 26 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.

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
31 --> 42	22

Medium pressure ducts with air velocities greater than 1,200 FPM:

<u>Dimensions of Longest Side</u> (inches)	<u>Minimum Sheet</u> <u>Metal Gauge</u>
Up thru 10	26
11 --> 12	24
13 --> 18	22
19 --> 22	20
23 --> 30	18

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.

FIRST & SECOND FLOOR FIT UP PROJECT
MERRILL'S WHARF, PORTLAND, ME

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. Clothes dryer ducts shall be use radius, non-segmented elbows.
8. Furnish and install flexible connections on all air handlers. 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.
10. Spaces between ducts and wall or floor construction shall be caulked to make smoke and water tight by this section. Sealant material shall be 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, return and exhaust

FIRST & SECOND FLOOR FIT UP PROJECT
MERRILL'S WHARF, PORTLAND, ME

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, Metalaire, 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 Registers: X3HOD with opposed blade damper and ¾ inch, 45° front blade spacing, front blades set horizontal.
 - d. Exhaust and Transfer Grilles: X3HD with ¾ inch, 45° front blade spacing, front blades set horizontal.
 - e. Filtered Return Grilles: Anemostat X3HD-81 filter grilles with hinged core, ¾ inch front blade spacing, front blades set horizontal. Provide filters with grilles as outlined in paragraph 2.11, "FILTERS".
2. Diffusers shall be installed at air supply openings where shown. 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, Metalaire, Price and Titus only will also be considered for review.
- a. Round face, steel construction, circular discharge, circular duct connection, fully adjustable core assembly, white finish. Model C-27 for 24 inch x24 inch lay-in application for units up to and including 8 inches in size. Units not installed in tile ceilings or larger than 8 inches shall be model C-27 without panel. Provide all units with type ED neck straightening grid. Straightening grids to be factory mounted.

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

D. Louvers

1. All exterior louvers shall be extruded aluminum construction with interior bird screens and anodized finish in color to be selected by Architect. Provide not less than 2 original color chip cards (clearly identified as to what they reference) to Architect for review (photocopies not acceptable). Frames and blades shall have not less than 55% minimum free area and no less than 0.081 inches thick. All louvers shall comply with Section 08400 of this specification. The following list is based on model numbers of Ruskin to establish a standard of quality; approved equal units by American Air Warming and Arrow are acceptable.

FIRST & SECOND FLOOR FIT UP PROJECT
MERRILL'S WHARF, PORTLAND, ME

2. All louvers shall be stationary blade type. Units to be 6 inches deep with certified rating of zero water penetration at free area velocity of 900 FPM based on tests in accordance with AMCA Standard 500. Units 48 inches and less in width shall be Model ELF6375X. Units greater than 48 inches in width shall have drainable blades, Model ELF6375DX.
3. Frames of all louvers to be box type for mounting in masonry. Provide factory mounting flanges on head and side jambs with extended sill for units mounted in frame walls.
4. Louvers in doors shall be provided as a part of the door by the General Contractor.

E. Duct Sleeves

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

F. Sealing of Ducts

All interior ductwork (except clothes dryer ducts) 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. For exterior applications, "Uni-Weather" (United McGill Corp.) neoprene based sealant shall be used. No other sealants may be used.

All seams and joints in shop and field fabricated ductwork shall be sealed by applying one layer of sealant, then immediately spanning the joint with a single layer of 3" wide open weave fiberglass tape. Sufficient additional sealant shall then be applied to completely imbed the cloth. All sealants shall be UL rated at no more than flame spread of 5 and smoke developed of 0. At contractor's option Hardcast 1602 sealant tape may be used in lap joints and flat seams.

G. Duct Access Doors

Hinged insulated access doors with seals shall be provided in ducts where indicated on drawings, or as required. Units shall be provided at each manual damper, motor operated damper, duct coil (both sides), duct mounted temperature control device and fire damper unless accessible through grilles and as shown on drawings. Units to be Ruskin Model ADH-22 for rectangular duct and Model ADR for round duct or approved equal by Elmdor.

H. Motor Operated Dampers

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

I. 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.

J. Fire Dampers

1. Fire dampers shall be installed to comply with NFPA Code No. 90A and shall bear a U.L. label. Provide fire rated access door at each fire damper not accessible through grille. All dampers shall comply with UL555 for dynamic testing and positive closure under air flow.
2. All fire dampers to be provided by damper manufacturer with integral sleeves and mounting angles. Sleeves provided "in-field" are not acceptable. Models indicated are Ruskin to establish a standard:
 - a. Wall types, 12 inches in height and less; Model IBD20, style "B".
 - b. Wall types, greater than 12 inches in height; Model IBD20, style "A".
 - c. Wall type behind grilles; Model IBDT, Style G
3. Provide factory mounted fusible links designed to melt at 165°F. and close the damper.
4. Installation shall be in accordance with damper manufacturer's instructions.

K. Flexible Duct

Provide and install insulated flexible duct where shown on drawings. Ducts 20 inches in diameter and smaller 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.

L. Side Takeoff Fittings (for flexible duct)

Provide and install at all flexible duct branches to registers and diffusers (where shown), a bellmouth side takeoff fitting similar with a manual damper and locking hand quadrant. Fittings shall be pre-manufactured with bell end shall have a 1½ inch radius and employ a self-adhesive gasket seal and be pre-drilled for attachment screws. 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.

M. 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 FILTERS

All filtered return grilles and cabinet unit heaters with filter banks, and separate filter boxes shall be provided with a minimum of three (3) sets of filters with pleated media (air handling units shall be provided with filters from the factory). One set to be used during construction (and replaced by the Mechanical Contractor during construction if required as determined by the Clerk of the Works and/or the Mechanical Engineer). Second set to be installed a minimum of one (1) day and a maximum of three (3) days prior to testing and balancing and/or final inspection. The third set shall be turned over to the Owner in their original unopened shipping boxes for their future use.

Filters shall be Farr 30/30, Air Guard DP-40 or approved equal, 1 inch thick.

2.12 EQUIPMENT IDENTIFICATION

Tag each new fan, air handler, outdoor unit, air to air heat recovery unit, refrigerant heat recovery unit and cabinet unit heater 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.

On air handlers, outdoor units, air to air heat recovery units and refrigerant heat recovery units, nameplates shall be 4 inches by 1½ inches, Setonply Style No. M1774. On all other units nameplates shall be 2½ inches by ¾ inch, Setonply Style No. M1771. Mount nameplates inside control access covers for cabinet unit heaters.

Identify all refrigerant piping with "Set Mark" full snap-around pipe markers by Seton Name Plate Corporation or approved equal by Brady Corp. Markers shall include both identification and direction of flow. Markers shall be no less than 10 feet apart where piping is concealed and not less than 20 feet apart where exposed. Identification shall read "Refrigerant Suction" and "Refrigerant Liquid" as applicable.

2.13 INSULATION AND CONDENSATE PROTECTION

A. General

1. Insulation shall be provided for all refrigerant piping, outside air intakes, exhaust and relief ducts (where specified) 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 shall be insulated with 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. Thickness shall be 2 inches on refrigerant piping and ½ inch on PEX tubing.
2. Exterior piping and fittings 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.

FIRST & SECOND FLOOR FIT UP PROJECT
MERRILL'S WHARF, PORTLAND, ME

6. Accessories such as adhesives, mastics and cements shall be provided by the insulation manufacturer and have the same properties as listed above and shall not detract from any of the system ratings as specified above.

D. Duct and Equipment Insulation

1. Duct duct insulation shall be a $\frac{3}{4}$ 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 the following ducts with 3 inches installed thickness fiberglass duct wrap:
 - a. Exhaust air ductwork for heat recovery units from louvers to motorized dampers.
 - b. Outdoor air intake ductwork for heat recovery units from louvers to unit connections.
3. 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.

E. 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.

F. Installation

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

2.14 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 the manufacturer of the heat pump system.
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 23 and 26 of this specification.

FIRST & SECOND FLOOR FIT UP PROJECT
MERRILL'S WHARF, PORTLAND, ME

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 ATC 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, dampers, damper operators, relays, transformers, labor 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. Heat pump systems including supplemental heating
2. Cabinet unit heaters
3. Fans operated by automatic temperature control system

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.
 - c. 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.

d. 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, except as noted. Power wiring for equipment shall be by Division 26, "ELECTRICAL".
2. ATC Contractor shall be responsible for coordinating installation of his wiring conduits with Division 26.

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. Valve and damper schedules showing size, configuration, capacity and location of all equipment.
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, valves, 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. Heat pump system: Thermostats shall be supplied with the heat pump system and installed by ATC.
2. Cabinet Unit heater thermostats: These shall be of line voltage, heavy duty all metal type and provided with clear plastic locking tamper proof covers.
3. Thermostats shall be mounted according to ADA requirements (<http://www.access-board.gov/adaag/html/adaag.htm#4.27>).
4. Provide clear plastic heavy duty locking guards over thermostats in Lobby 126 and elsewhere as indicated.

J. Miscellaneous Devices

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

K. Dampers

1. Motorized 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. ALL DAMPERS SHALL BE MOUNTED WITH BLADES ORIENTED HORIZONTALLY.
2. Damper operators shall 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. Heat recovery units

Units to be provided with a start/stop signal from the unit control panels. Provide motorized dampers in the supply and exhaust mains where shown. Dampers to open whenever unit is activated. Provide a low temperature sensor in the discharge duct of each unit downstream of the motor operated isolation dampers. Should supply air temperature fall below 40°F the unit supply fan shall be shut down and the damper in the supply duct closed. Include a timing cycle to permit restart of the supply fan after 10 minutes. Provide a fault light at each control panel to indicate shutdown of the supply fan.

2. Fans shall operate as indicated on "FAN SCHEDULE" on sheet M4. Provide 120 volt motor operated dampers to open when fans cycle; wiring by Division 26 unless noted otherwise.

Exhaust Fan No. 14 to be controlled by a line voltage cooling thermostat. Fan to start and respective motorized dampers to open when the room temperature exceeds setpoint.

3. Cabinet Unit Heater

Unit to be supplied with line 120 volt thermostat and relay furnished and installed by ATC Contractor.

4. Heat Pump System

Heat pump system shall be supplied with all control devices by the system manufacturer. Devices, wiring and programming of systems shall be performed by factory authorized personnel trained in the installation of the system. See Par. 2.07, "HEAT PUMP SYSTEMS".

5. Electric Duct Heating Coils

Coils to come from the manufacturer with relays to activate or deactivate coils. Heat pump system control installer shall wire from each air handler control to its associated booster coil. Should the outdoor temperature be too cold to effectively heat the building the duct heating coils shall be activated to supplement as needed by the space thermostats.

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 PIPING AND EQUIPMENT

A. General

1. Size and general arrangements as well as methods of connecting all piping and equipment shall be as indicated, or to meet requirements for complete installation.
2. All piping shall be run level and erected to provide for easy and noiseless passage of refrigerant under all working conditions.
3. All condensate drain piping shall be pitched downward in the direction of flow by not less than 1/8 inch per foot of run.
4. Install pipes to clear all beams and obstructions; do not cut into or reduce the size of load carrying members without the approval of the Architect.
5. All risers and offsets shall be substantially supported.
6. Maximum spacing of hangers for rigid copper piping shall be as follows:

<u>Pipe Size</u>	<u>Spacing</u>
1/2", 3/4" & 1"	6'-0"
1 1/4" & 1 1/2"	6'-0"
2" & 3"	10'-0"

B. Joints and Connections

1. Smoothly ream all cut pipe; cut all threads straight and true; apply best quality
2. Make all joints in copper tube (water and drains) with 95-5 tin-antimony solder applied in strict accordance with the manufacturer's recommendations.
3. All joints in refrigerant tubing shall be brazed.

C. Fire Safety

Fire extinguishing equipment shall be kept within 25 feet of soldering areas at all times. Take additional precautionary measures when soldering close to wood structures to protect the wood from igniting.

3.03 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. 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.

3.04 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. ATC 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. Fire and volume dampers are in place and open.
 - h. Air coil fins are cleaned and combed.
 - 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 General Contractor. 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 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. Mechanical Contractor shall provide copies of shop drawings indicating fan air volumes, air handling unit air volumes, etc. to the Testing and Balancing contractor at no cost to the contractor.

FIRST & SECOND FLOOR FIT UP PROJECT
MERRILL'S WHARF, PORTLAND, ME

5. 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.
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 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.
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. Adjust air discharge patterns of all supply air diffusers, registers and grilles for optimal air diffusion.

FIRST & SECOND FLOOR FIT UP PROJECT
MERRILL'S WHARF, PORTLAND, ME

9. 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.
10. Reports shall be compiled on a spreadsheet such as Excel, Quattro-Pro, Lotus, etc. and shall clearly indicate the following *minimum* information:
 - a. System/unit name
 - b. HP, BHP, voltage, amperage and fan rpm
 - c. Static pressures; suction, discharge and total
 - 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. 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

3.05 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 to permit time for scheduling inspections.

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.

3.06 TEMPORARY HEATING

- A. Mechanical Contractor shall install the new systems 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.

3.07 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 air handling units, fans and cabinet unit heaters. Clean the interiors of ductwork as outlined in 3.03, "INSTALLATION OF DUCTWORK AND EQUIPMENT"; paragraph "B", "Protection and Cleaning".

3.08 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 two (2) hours. (Temperature control system instruction shall be in addition to this instruction period). The time of instruction shall be arranged with the Owner.

3.09 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.

3.10 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.

3.11 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