

**17 BISHOP STREET  
WHIPPLE|CALLENDER ARCHITECTS  
DECEMBER 20, 2017**

**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 alternates that apply to this section of the project. See Part 4, "ALTERNATES".

1.03 DEFINITIONS

ATC Automatic Temperature Control  
EC Electrical Contractor  
GC General Contractor  
HC Heating (mechanical) Contractor  
PC Plumbing Contractor  
TAB Testing and Balancing

1.04 DESCRIPTION OF WORK

A. Work Included

1. Furnish all labor, materials, equipment, transportation and perform all operations required to install complete heating, ventilating and air conditioning systems in the building, in accordance with these specifications and applicable drawings.
2. All temperatures are expressed in degrees Fahrenheit.
3. Perform demolition and removal as required.
4. Work to be performed shall include, but is not limited to, the following:
  - a. Provide and install forced hot air heating and ventilating system in building areas indicated on drawings.
  - b. Provide and install direct expansion air conditioning system in building areas indicated on drawings.
  - c. Air handling units
  - d. Insulation
  - e. Fans
  - f. Sheetmetal
  - g. Automatic Temperature Control (ATC)
  - h. Tests and balance
5. Specifications and accompanying drawings do not indicate every detail of ductwork and equipment necessary for complete installation; but are provided to show general arrangement and extent of work to be performed.

6. Before submitting proposal, Mechanical Contractor shall be familiar with all conditions. Failure to do so does not relieve Mechanical Contractor of responsibility regarding satisfactory installation of the system.
7. Mechanical contractor shall be responsible for rigging to hoist his own (and his sub-contractors') materials and equipment into place.
8. Mechanical contractor and his sub-contractors shall be responsible for start-up of all equipment provided under this section.

B. Related Work Not Provided

1. Cutting and patching
2. Fire and smoke stopping between building construction and ductwork.
3. Roofing, setting of curbs and framing of openings.
4. Gas piping
5. All finish work

C. Mechanical Electrical Work

1. Provide and erect all motors, temperature controls, limit switches as specified.
2. Power supply to mechanical equipment requiring power shall be furnished and installed by a licensed electrician outside of this specification. Coordinate all wiring between Mechanical and Electrical to provide a complete and operating system.
3. All wiring provided under this section shall comply with the requirements of the latest rules and regulations of the National Fire Underwriters, National Electric code and Local Codes.
4. Automatic Temperature Control (ATC) Systems  
  
Low voltage control wiring shall be furnished and installed by ATC Contractor.  
  
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. New Air Handling Unit  
  
Electrician shall provide a circuit with a disconnect mounted at the unit, then wire power to the terminals in the unit.
6. New Makeup Air Unit  
Electrician shall provide a circuit with a disconnect mounted at the unit, then wire power to the terminals in the unit.
7. Fans
  - a. Single phase 120 volt units: Electrician to wire to unit mounted disconnect switch with overload protection provided with unit.

- b. Three phase units: Electrician shall provide combination disconnect switches with magnetic starters unless specifically indicated otherwise, and wire power to supply through to line terminals on unit motor. Starters shall have auxiliary contactors for 120 volt toggle switches.
- c. Fans shall operate as indicated on "FAN SCHEDULE", drawing M3 and as indicated in "Automatic Temperature Control" section of this specification.

8. Smoke Dampers

Electrician shall wire the actuators to the central fire alarm panel. Dampers to close when the system detects smoke in the ductwork.

9. Kitchen Hood

Control and power wiring for kitchen hood exhaust fan, lights and fire extinguishing system shall be wired by the electrician.

10. Dishwash Hood Motor

Control and power wiring for dishwasher hood exhaust system shall be wired by the Electrician.

11. Convenience Receptacles

The electrician is requested to provide and install a duplex receptacle in a weather proof enclosure on the roof in the vicinity of the Makeup Air Unit.

1.05 PERMITS

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

1.06 CODES, ORDINANCES AND PERMITS

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

AABC	Associated Air Balance Council
ADA	Americans With Disabilities Act
AMCA	Air Movement & Control Association
ANSI	American National Standards Institute
ARI	Air Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers

ASTM	American Society for Testing and Materials
IBC	International Building Code
NEC	National Electrical Code
NFPA	National Fire Protection Association
NEMA	National Electrical Manufacturer's Association
OSHA	Occupational Safety and Health Act
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
UL	Underwriter's Laboratories

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

#### 1.07 QUALITY ASSURANCE

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

#### 1.08 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.

## 1.09 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 will be provided in the 2010 file format. Upon request for CAD files a release form will be provided which must be signed and returned to the Architect 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. E-mail requests may be made at [rob@mechanicalsystemseng.com](mailto:rob@mechanicalsystemseng.com)

## 1.10 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 not mentioned in this specification shall be made in writing via letter or e-mail to the Architect and/or Engineer up to four working days prior to opening of bids to permit sufficient time to notify all bidders via addenda. Any requests made after the final addenda prior to bid opening will not be considered. Contractor must certify within his submittals that any equipment or materials requested 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 while providing adequate clearances for servicing of equipment as required by the manufacturers and will not interfere with other trades. Architect will not be responsible to provide drawings for substituted materials unless the substitution is agreed upon prior to opening of bids.
- B. The phrase "or approved equal" shall be defined to mean the Architect shall make final determination whether or not substitute materials are an equal to that which is specified. 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.
- C. 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 Architect's decision on acceptability of substitute materials shall be final. Architect's decision on acceptability of substitute materials shall be final.
- D. 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.
- E. Costs associated with substitutions not previously approved and circulated by addenda prior to bidding shall be borne by the Div. 23 contractor. Those costs shall include, but not be limited to, electrical, structural, piping, insulation, cutting and patching, etc.
- F. It shall be the responsibility of the General Contractor to ensure all affected sub-contractors are provided with information specific to their trades regarding substitutions for coordination and pricing (where applicable).

## 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 review comments. If original or re-submitted shop drawings are not submitted within the allotted time frames indicated all substitutions included in the late shop drawings will, at the Architect's discretion, be invalid and the equipment primarily specified must be provided. Any costs resulting from delays in the project schedule due to failure to submit shop drawings related to this section in a timely manner shall be the responsibility of the Mechanical Contractor. Mechanical Contractor's and vendor's name, address, telephone number and e-mail addresses shall be provided with every shop drawing submission. Capacities indicated are minimums. Equipment submitted with capacities below specified parameters will be refused.
- B. Shop drawings shall be properly identified and shall describe in detail the material and equipment to be provided, including all dimensional data, performance data clearly indicated, fan curves, pump curves, computer selection print-outs, etc. Capacities indicated are minimums. Equipment submitted with capacities below specified parameters will be refused.
- C. Corrections or comments made on the shop drawings do not relieve the contractor from compliance with requirements of the drawings and specifications. Shop drawing review is only for review of general conformance with the design concept of the project and general compliance with the information given in the contract documents. The contractor is responsible for confirming and correlating all quantities and dimensions, selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades and performing his work in a safe and satisfactory manner.
- D. Should any materials or products be purchased and/or installed without prior review and comment the contractor shall be required to remove or replace those products and/or materials, if directed by the Architect, at his expense. If the materials are not removed (or replaced) or if the project is delayed as a result of the contractor's actions, the Architect reserves the right to order the withholding of payment until the situation is resolved in a manner satisfactory to the Architect.
- E. Submittals shall be identified by job title, specification section and paragraph number. Items under each paragraph may be combined into one submittal but do not combine items from multiple paragraphs. For instance, do not combine items specified under par 2.01 with items specified under par. 2.02.
- F. Shop drawings are required to be submitted electronically (paper copies will not be accepted). Resolution on files in .pdf format shall be a minimum of 300 dpi and a maximum of 600 dpi. Electronic files must be accessible and in an open format, meaning files must not be locked and comments may be added without altering the original content, or have interactive fields intended specifically for commenting. Locked files will not be reviewed. Exception: Color samples, where required, must be provided to the Architect in the form of original paper copies. Electronic color samples are not acceptable due to differences in monitor color rendition. Faxed copies of color samples will be refused.

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. Smoke dampers and sleeves
  - f. Turning vanes
  - g. Side takeoff fittings
  - h. Flexible duct
  - i. Kitchen range hood, fire extinguishing system, grease filters and accessories
  - j. Dishwash hood and accessories
  - k. Backdraft dampers
  - l. Intake roof jacks
  - m. Manual dampers
  - n. Filters
2. Mechanical Equipment (sound data must be provided with all interior motorized equipment).
  - a. Full warrantee information must be included with all submittals.
  - b. Air handling units and accessories - provide curves for fan wheels submitted and computer selection printouts.
  - c. Direct expansion duct cooling coils (see Part 4, "ALTERNATES")
  - d. Compressor/Condenser Units Boiler feed unit (see Part 4, "ALTERNATES")
  - e. Fans and accessories - provide full fan curves and computer selection printouts.
3. Insulation
  - a. Duct
  - b. Equipment
  - c. Pipe
  - d. Pipe fittings
  - e. Smoke pipe, air separator and storage water heater
4. Qualifications and Certifications
  - a. Certification(s) of Testing and Balancing Contractor
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 special 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 drawings must be kept up to date by recording all changes within one week of the time that the changes are authorized. At the completion of the work, this set of drawings shall be delivered to the Architect for the Owner electronically in the form of CAD drawings or .pdf format with markups in red. If a complete record of changes is not made and electronic drawings not provided by the Mechanical Contractor, a record shall be made by the Architect, and the cost of the record shall be the responsibility of the Mechanical Contractor. Copies of the mechanical CAD drawings (minus professional licensing seals) may be made available at no cost to the Mechanical Contractor of record if desired. Drawings shall be dated accordingly and clearly identified as "AS-BUILT". See par. 1.09, "ELECTRONIC DRAWINGS AND FILE SHARING" for additional information.

1.14 MAINTENANCE MANUAL

A. On completion of this portion of the work, and as a condition of its acceptance, submit for approval two copies of a manual describing the system. Mechanical equipment manuals shall be separate from plumbing manuals. All manuals shall be original copies, not photocopies or they will be refused for re-submittal. Prepare manuals in durable 3-ring binders approximately 8½ inches by 11 inches in size with at least the following:

1. Identification on the front cover and spine stating general nature of the manual.
2. Complete instructions regarding operation and maintenance of all equipment involved.
3. Complete nomenclature of all replaceable parts, their part numbers, current cost, and name, address and telephone number of nearest vendor of parts.
4. Copy of all guarantees and warranties issued.
5. Copy of reviewed submittals
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.
7. Copies of signed documentation of factory startup signed by an authorized factory technicians for pumps and boilers.

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. These may be incorporated in Maintenance Manuals, if binders are of adequate size. Also, include (2) CD's with all electronic shop drawings and catalog cuts.

1.15 OBJECTIONABLE NOISE AND VIBRATION

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



## 1.16 GUARANTEE

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

## 1.17 DEVIATIONS AND DISCREPANCIES

- A. The drawings are intended to indicate only diagrammatically the extent, general character and approximate locations of mechanical work. Work indicated, but having minor details obviously omitted, shall be furnished complete to perform the functions intended without additional cost to the Owner. Follow the architectural, structural, plumbing and electrical drawings so that work under this section is properly installed and coordinated with other Sections.
- B. The drawings and specifications are complimentary to each other and what is called for in one, shall be as binding as if called for by both. In the event of conflicting information on Div. 23 drawings, or between Div. 23 drawings and this specification notify the Architect immediately so a clarification may be issued by addenda.
- C. Questions to the Architect and/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. Inquiries 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 Architect.
- B. All requests for change in contract price and scope shall be accompanied by a breakdown list of materials with unit and extended prices and labor hours with unit and extended price, plus markups that have been applied.

## 1.19 COORDINATION

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

## 1.20 REQUESTS FOR INFORMATION

Requests for Information (RFI) or other correspondences which are submitted electronically must be in an open format, meaning files must not be locked and comments may be added without altering the original content, or have interactive fields intended specifically for commenting. No software other than Microsoft Word, Microsoft Excel and Adobe Acrobat Standard shall be required to open files or make comments.

## 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 new refrigerant piping (see Part 4, "ALTERNATES"). 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 "K" hard drawn copper tubing mains and ACR copper tube branches to air handlers.

#### C. Pipe Fittings:

1. Refrigerant Cast bronze or wrought copper, long radius elbows, brazed.

### 2.02 PIPE HANGERS AND SUPPORTS (see Part 4, "ALTERNATES")

#### 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 refrigerant piping shall be sized to include the insulation and include thermal hanger shields (insulated pipe supports).

Hangers for piping shall be steel, band type; plain for steel pipe and copper plated for copper tubing. Carpenter & Paterson, Inc., Fig. 1A (Fig. 1A CT copper plated) or approved equal.

4. Thermal hanger shields shall be Carpenter & Paterson, Inc., Fig. 265P or approved equal.

#### B. Supports

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

### 2.03 FIRE AND SMOKE SEALING

#### A. Material

Sealant material shall be 3M brand fire barrier caulk CP25 or putty 303, Ciba-Geigy CS240 Firestop Sealant, or approved equal and shall be U.L. listed.

B. Ductwork

Voids between ductwork and walls/floors shall be sealed fire and smoke tight by this contractor.

2.04 REFRIGERANT SPECIALTIES (see Part 4, "ALTERNATES")

- 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 the systemS.
- 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 DUCT COOLING COILS (see Part 4, "ALTERNATES")

A. General

Furnish and install, where indicated, duct mounted direct expansion cooling coils. Coils shall be sized to match physical dimensions of existing coils but not more than 500 FPM face velocity at 1,600 CFM. Coils matched with their corresponding outdoor compressor/condenser units for optimal performance. Coils shall include drain pans.

- B. Coils shall be designed with aluminum plate fins and copper tubes. Fins have collars drawn, belled and firmly bonded to the tubes by means of mechanical expansion of the tubes. Coils shall have airflow arrows and nameplate attached to coil casing. Coils shall be certified in accordance with the AHRI Forced-Circulation Air-Cooling and Air-Heating Coils Certification Program which is based on AHRI Standard 410 within the Range of Standard Rating Conditions listed in Table 1 of the Standard. Certified units may be found in the AHRI Directory at <http://www.ahridirectory.org>.
- C. Coils shall have ½ inch 00 copper tubes. Suction headers shall be made of copper tubing, distributor connections shall be brass and both allow for sweat connection of refrigerant lines. Coils shall have a vertical distributor to ensure that each coil circuit receives the same amount of refrigerant liquid. Coils shall be proof tested to 450 psig and leak tested to 300 psig air pressure under water. Coils shall be dried after testing and filled with a 10 psig holding charge of dry air. Working pressure shall be 300 psig at 250°F. Refrigeration specialties such as TXV valves, line driers, sight glasses, etc., are not included from the factory and must be field supplied. Fins shall be aluminum.

D. Capacities

Coils shall be sized Water headers shall be seamless copper tubing with intruded tube holes to permit expansion and contraction without creating undue stress or strain. Vent connections shall be provided at the highest point.

E. Casing

Casing shall be constructed of continuous galvanized steel with 3/8 inch diameter bolt holes for flange mounting at 6 inch centers. Coil side plates shall also be of continuous galvanized steel of reinforced flange type construction for greater strength.

E. Coil shall be of the same manufacturer as the corresponding compressor/condenser unit.

2.06 COMPRESSOR/CONDENSER UNITS (SEE PART 4, "ALTERNATES")

A. General

Provide and install new compressor/condenser units as replacement for existing equipment. Capacities are scheduled on sheet M3. Units shall be fully charged from the factory for up to 180 feet of piping. Units shall be designed to operate at outdoor ambient temperatures as high as 115°F. Cooling capacities shall be matched with the indoor DX coils and shall be AHRI certified. The unit is certified to UL 1995. Exteriors shall be designed for outdoor applications.

B. Casings

Unit casings shall be constructed of heavy gauge, galvanized steel and painted with a weather-resistant powder paint finish on all louvered panels and the fan top panel. The corner panels shall be repainted. All panels shall be subjected to our 1,000 hour salt spray test.

C. Bases shall be made of a CMBP-G30 weatherproof material to resist corrosion.

D. Refrigerant Controls

Refrigeration system controls shall include condenser fan, compressor contactor and high pressure switch. High and low pressure controls shall be inherent to the compressor. A factory supplied liquid line drier for field installation shall be standard.

E. Compressor

Compressors shall feature internal over temperature, pressure protection and total dipped hermetic motor. Centrifugal oil pump and low vibration and noise shall be included.

F. Condenser Coil

The outdoor coil shall provide low airflow resistance and efficient heat transfer. Coils shall be protected on all four sides by louvered panels.

G. Trane 4TTR6 or approved equal

## 2.07 AIR HANDLER #1

### A. General

Furnish and install a rooftop packaged heating and cooling unit with a natural gas furnace and direct expansion air conditioning. Unit shall be curb mounted with downflow configuration. The (cooling) operating range shall be between 115°F and 40°F in cooling as standard. Cooling performance shall be rated in accordance with ARI testing procedures. Unit shall be factory assembled, internally wired, fully charged with R-410A, and 100 percent run tested to check cooling operation, fan and blower rotation, and control sequence before leaving the factory. Wiring internal to the unit shall be colored and numbered for simplified identification. Unit shall be cULus listed and labeled, classified in accordance for Central Cooling Air Conditioners.

### B. Casing

Unit casing shall be constructed of zinc coated, heavy gauge, galvanized steel. Exterior surfaces shall be cleaned, phosphatized, and finished with a weather-resistant baked enamel finish. Unit's surface shall be tested 672 hours in a salt spray test in compliance with ASTM 8117. Cabinet construction shall allow for all maintenance on one side of the unit. Service panels shall have lifting handles and be removed and reinstalled by removing two fasteners while providing a water and air tight seal. All exposed vertical panels and top covers in the indoor air section shall be insulated with a cleanable foil-faced, fire-retardant permanent, odorless glass fiber material. The base of the unit shall be insulated with 1/8 inch, foil-faced, closed-cell insulation. All insulation edges shall be either captured or sealed. The unit's base pan shall have no penetrations within the perimeter of the curb other than the raised 1.1/8 inch high downflow supply/return openings to provide an added water integrity precaution, if the condensate drain backs up. The base of the unit shall have provisions for forklift and crane lifting, with forklift capabilities on three sides of the unit.

### C. Unit Top

The top cover shall be one piece construction or, where seams exist, it shall be double-hemmed and gasket-sealed. The ribbed top adds extra strength and enhances water removal from unit top.

### D. Compressor

Unit shall have direct driven, hermetic, scroll type compressor with centrifugal type oil pumps. Motor shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate voltage. Internal overloads shall be provided with the compressor. Crankcase heaters shall be standard equipment.

### E. Indoor Fan

Fan shall be a multispeed, direct drive. All motors shall be thermally protected. Fan motor meet the U.S. Energy Policy Act of 1992 (EPACT).

### F. Outdoor Fan

The outdoor fan shall be direct drive, statically and dynamically balanced, draw-through in the vertical discharge position. The fan motor shall be permanently lubricated and shall have built-in thermal overload protection.

G. Evaporator and Condenser Coils

Coils shall be internally finned, 8 mm copper tubes mechanically bonded to a configured aluminum plate fin shall be standard. Microchannel condenser coils shall be standard. Compact all-aluminum microchannel coils also help to reduce the unit weight. Coils shall be leak tested at the factory to ensure the pressure integrity. The evaporator coil and condenser coil shall be leak tested to 600 psig. The assembled unit shall be leak tested to 465 psig. The condenser coil shall have slight gaps for ease of cleaning. A plastic, dual-sloped, removable and reversible condensate drain pan with through-the-base condensate drain shall be provided.

H. Controls

Unit shall be completely factory-wired with necessary controls and contactor pressure lugs or terminal block for power wiring. Unit shall provide an external location for mounting a fused disconnect device. Controls shall be microprocessor and shall provide for all 24V control functions. The resident control algorithms shall make all heating, cooling, and/or ventilating decisions in response to electronic signals from sensors measuring indoor and outdoor temperatures. The control algorithm shall maintain accurate temperature control, minimizes drift from set point, and provides better building comfort. A centralized microprocessor shall provide anti-short cycle timing and time delay between compressors provide a higher level of machine protection. High pressure control shall also be provided.

Provide a digital thermostat with capability of programming up to two occupied/unoccupied periods per day, seven days a week. Thermostat shall have an LED or LCD display and have the ability of switching from heating to cooling automatically or be over-ridden for manual use. Provide a clear plastic locking tamper-proof cover.

Control sequence shall be as follows:

Unoccupied modes:

Cooling - Unit shall be disabled and outdoor air damper shall be closed.

Heating - Unit shall operate on reduced temperature as programmed. Unit fan shall cycle as needed to provide heat. Outdoor air damper shall be closed.

Occupied modes:

Cooling - Unit fan shall operate continuously and outdoor air damper shall open to 10%. Compressor shall cycle as needed to satisfy cooling set point. A dry bulb economizer shall stop compressor and open outdoor air damper beyond the minimum setpoint should outdoor air temperature be sufficient to cool the space.

Heating - Unit fans shall operate continuously and outdoor air damper shall open to 10%. Gas furnace shall modulate to provide heat as needed to satisfy thermostat setpoint. A low limit sensor shall reduce outside air intake should discharge temperature drop below thermostat setpoint.

I. Phase monitor

Phase monitor shall provide 100% protection for motors and compressors against problems caused by phase loss, phase imbalance, and phase reversal. Phase monitor shall be equipped with an LED that provides an ON or FAULT indicator. There shall be no field adjustments. The module will automatically reset from a fault condition.

J. Refrigerant Circuits

Each refrigerant circuit shall have a thermal expansion valve. Service pressure ports, and refrigerant line filter driers shall be factory-installed. An area shall be provided for replacement suction line driers.

K. Gas Heating Section

The heating section shall have a progressive tubular heat exchanger design using stainless steel burners and corrosion resistant steel throughout. An induced draft combustion blower shall be used to pull the combustion products through the firing tubes. The heater shall use a direct spark ignition (051) system. On initial call for heat, the combustion blower shall purge the heat exchanger for 20 seconds before ignition. After three unsuccessful ignition attempts, the entire heating system shall be locked out until manually reset at the thermostat/zone sensor. Unit shall be suitable for use with natural gas or propane (field-installed kit) and also comply with the California requirement for low NOx emissions.

L. Economizer

Economizer shall be provided with a barometric relief. The assembly shall include fully modulating 0-100 percent motor and dampers, minimum position setting (10%) , preset linkage, wiring harness with plug, spring return actuator and fixed dry bulb control. The barometric relief shall provide a pressure operated damper that shall be gravity closing and shall prohibit entrance of outside air during the equipment off cycle.

M. Through the Base Electrical Access

An electrical service entrance shall be provided allowing electrical access for both control and main power connections inside the curb and through the base of the unit. This shall allow for field installation of liquid-tight conduit and an external field-installed disconnect switch.

N. Curb

Roof curb shall be insulated, self flashing, not less than 12 inches in height. Curb shall be supplied by air handler manufacturer.

O. Unit shall be Trane YHC-036 or approved equal.

2.08 MAKEUP AIR UNIT

A. Provide and install a rooftop, curb mounted makeup air unit for the kitchen cooking hood. Unit shall be 100% outdoor air, downflow configuration with a natural gas furnace. Roof curb shall be provided with the unit and be self-flashing for flat roofs with EPDM and rolled roofing materials. Curb height shall be not less than 20 inches. Unit shall be direct gas fired with a 10 inch blower.

B. Furnace shall be natural gas fired and include the following:

1. Intake hood with removable, cleanable aluminum filters.
2. Motorized backdraft damper, standard galvanized steel construction with ¾ inch rear flange and actuator.
3. Modulating furnace output.



4. Low fire start to permit the burner circuit to energize when the modulating control is in a low fire position.
  5. Gas pressure gauge, -5 to +15 inches wc, 2½ inch diameter, ¼ inch thread.
  6. Three year extended warranty for fan motor parts.
  7. Extra set of belts
  8. Prewired variable frequency drive (VFD) for use with the cooking hood demand control ventilation system, see par. 2.13, "COOKING HOOD DEMAND CONTROL VENTILATION"
  9. 120 VAC wiring package.
- C. Burners shall be direct fired with self-adjusting profile plates for even air velocity and pressure drop. By-product levels shall not exceed 5ppm of carbon monoxide and 0.5ppm of nitrogen oxide. Profile plates shall be spring loaded for compatibility with demand control ventilation. Profile plate assemblies shall be included unit ETL listing and comply with combined safety standards ANSI Z83.4 and CSA 3.7 (non-recirculating DF headers) and ANSI Z83.18 (recirculating DF headers). Profile plates shall be formed from G90 galvanized steel.
- D. Unit casing shall include a hinged blower and motor access door. Casing shall have salt spray coating.
- E. CaptiveAire Model A1-D.250-G10 or approved equal.

## 2.09 FANS

### A. General

1. Fans with capacity and types shown on the drawings shall be provided and installed. All roof curbs, unless otherwise noted, shall be provided by the fan manufacturer and installed by the General Contractor. This Contractor shall furnish the General Contractor with the correct sizes of roof curbs for sizing roof openings. Equivalent units by Acme, Greenheck, Panasonic and Penn ONLY will be considered.
2. Fan selection shall be based on sloping portion of curve with spare capacity of 20% of total CFM and static pressure without increasing motor size. **Provide full fan curves with submittals that shown the entire operating range of the fan - not just the operating point. Fans that are submitted without this data will not be accepted.**
3. All fans 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. All three phase motors shall be inverter ready and premium efficiency.
4. Wall caps shall not be provided with fans. Caps are specified in 2.14, "SHEETMETAL".

## B. Types

1. Exhaust fans 8 and 9 shall be ceiling mounted, humidity sensing exhaust fans, Nutone QTXEN110S Fans or approved equal by Broan, Panasonic or Greenheck.

Fans shall be Energy Star Qualified. Fans shall include an internal humidity control to automatically turn fan on in either a rapid to moderate (owner adjustable) increase of humidity OR humidity above a user-adjustable set-point (50%-100% RH). Fan is also to be energized any time the light switch is on.

2. EF-1 and EF-2 shall be a curb mounted, centrifugal roof exhauster, upblast configuration. Fans shall be a spun aluminum, roof mounted, direct drive. Fan shall be engineered to discharge grease laden vapors, fumes and other contaminants vertically away from the building.

EF-1 shall be ETL Listed and comply with UL705 (electrical) Standards and CSA Std C22.2, No 113. EF-2 shall be ETL Listed and comply with UL762 Standards. Fans shall bear the AMCA certified ratings seal for sound and air performance.

The fan windband shall be constructed of heavy gauge aluminum or G90 Galvanized and shall be spun on an automatic lathe to provide consistent dimensions. Horizontal and vertical internal supports shall be used to securely fasten the windband to the discharge apron to provide rigidity for hinging and added strength to reduce shipping damage. The discharge apron shall have a rolled bead for added strength.

Bases shall be constructed of galvanized steel for improved rigidity. Base corners shall be welded to provide strength and support for hinging and cleaning and to prevent leakage into the building.

Fan wheels shall be centrifugal backward inclined and non-overloading. Wheels shall be balanced in two planes and done in accordance with AMCA standard 204-96, *Balance Quality and Vibration Levels for Fans*. The wheel blades shall be aerodynamically designed to minimize turbulence, increase efficiency and reduce noise. The wheel blades shall be welded to the wheel inlet cone. In the event that balancing weights are required they shall be riveted to the blades or wheel. The wheel inlet shall overlap the fan base inlet for maximum performance and efficiency. The wheel shall be firmly attached to the motor shaft with two set screws.

Motors shall be open drip and shall be permanently lubricated, rated for continuous duty and thermally protected. Motors shall be mounted out of the airstream and furnished at the specified voltage, phase and enclosure. Motor mounting plate shall be constructed of heavy gauge galvanized steel. The motor compartment shall be cooled by outside air drawn through an extruded aluminum conduit tube. To seal the conduit tube passage and prevent noise silicone rubber grommets shall isolate the conduit tube from the fan housing. The motor compartment shall be of a two-piece construction with the cap having quick release clips to provide quick and easy access to the motor compartment.

EF-1 shall have a grease spout made of aluminum tubing shall be welded to the fan housing. The weld shall be factory tested to ensure it will not leak.

Provide EF-1 with a variable frequency drive (VFD) compatible for use with the cooking hood demand control ventilation system, see par. 2.13, "COOKING HOOD DEMAND CONTROL VENTILATION"

To provide a tight seal all fasteners in the fan housing shall be backed with nylon washers.

Roof curbs shall be provided by the fan manufacturer and be not less than 24 inches high, double wall construction, insulated with not less than 1½ inch thick 3 lbs density insulation, self-flashing type designed for EPDM or rolled roofing systems on a flat surface. Curbs shall include a damper shelf and be structurally designed to adequately support no less than twice the weight of the equipment to be placed on them. Curbs shall be vented.

Fans shall be model DU-HFA as manufactured by CaptiveAire Systems or approved equal.

## 2.10 DISHWASH HOOD

- A. Provide and install and single wall canopy type vapor removal hood where shown on the drawings.
- B. Hood shall be constructed of Type 430 stainless steel, #3 or #4 polish, on all exposed surfaces when used in condensate applications. Pre-punched hanging angles on each end of hood.
- C. Hood shall incorporate an integral 4-sided perimeter gutter and one drain standard for high-moisture exhaust.
- D. Hood shall include a top exhaust riser.
- E. CaptiveAire Model 4812VHB-G or approved equal

## 2.11 COOKING HOOD

- A. Provide and install and double wall canopy type kitchen range hood where shown on the drawings. One inch of insulation shall be provided between the walls to permit zero clearance to combustible construction. Construction shall be Type 430 stainless steel with polished surfaces on the interior and exterior of the front, fully welded and polished front corners.
- B. Hood shall carry seal of U.L., N.S.F. and N.F.P.A. 96.
- C. Hood shall include an insulated internal standoff in the back.
- D. Hood shall include a full height backsplash of the same material as the hood, an exhaust riser, grease pan with removable cup, (3) internally wired UL labeled light fixtures, grease filters, fire extinguishing system and controls.
- E. Hood shall also include a makeup air plenum with a continuous 23.5% open stainless steel perforated panel and supply duct risers with volume dampers.

- F. Grease filters shall be removable for cleaning. Filters shall fit into standard two inch channels, include stainless steel handles and a fastening device to secure two components when assembled. Grease extraction performance shall remove not less than 75% of grease particles five microns in size and 85% grease particles seven microns in size and larger. Pressure drop shall not exceed 1.0 inches of water gauge. Filters shall be in compliance with NFPA 69, NSF #2, UL 1046, ULC-S649 and the International Mechanical Code.
- G. Hood shall be Captiveaire Model 5412SND-2-PSP-FSS or approved equal.
- H. Grease filters shall be Captrate Gease-Stop Solo Filter or approved equal.

## 2.12 COOKING EXHAUST HOOD FIRE EXTINGUISHING SYSTEM

- A. Furnish and install fire extinguishing system, complete, in kitchen hood and duct systems to meet BOCA Code and requirements of latest edition of NFPA 96. Systems to be "Range Guard" wet chemical type, equal to KARBALOY II by Automatic Sprinkler Corp., and protect kitchen hood, plenum, grease filters, exhaust duct, cooking appliance, and supplied with adequate size bottles as required. All devices furnished shall be constructed and installed in accordance with manufacturer's instructions and shall be in accordance with UL-300 requirements.
- B. System to be provided with:
  1. Controls including remote manual pull station, heat triggered activation and provision for automatic appliance power shut-off.
  2. Pressure switch with two (2) dry contacts and interposing relay for connection to fire alarm system and electric shut-off for cooking equipment.
  3. Div. 22 to provide mechanically operated shut-off valve on gas supply pipe to cooking equipment. Connection to fire extinguishing system shall be by this section.
  4. Complete piping system of schedule 40 steel pipe with malleable iron fittings. Exposed piping shall be chrome plated and have stainless steel or chrome plated elbows, fittings and chrome plated tubing sleeves.
  5. Semi-annual factory authorized inspection of system during 12 month warranty period.

## 2.13 COOKING HOOD DEMAND CONTROL VENTILATION

- A. Provide and install a control system for demand control ventilation. Controls shall be provided with the hood and listed by ETL (UL 50BA) and shall comply with demand ventilation system turndown requirements outlined in IECC 403.2.B (2015).
- B. The control enclosure shall be NEMA 1 rated and listed for installation inside of the exhaust hood utility cabinet. The control enclosure may be constructed of stainless steel or painted steel.
- C. A temperature probe located in the exhaust duct riser shall be constructed of stainless steel.
- D. A digital controller shall be provided to activate the hood exhaust fans dynamically based on a fixed differential between the ambient and duct temperatures sensors. This function shall meet the requirements of IMC 5.7.1.1.

- E. A digital controller shall provide adjustable hysteresis settings to prevent cycling of the fans after the cooking appliances have been turned off and/or the heat in the exhaust system is reduced.
- F. A digital controller shall provide an adjustable minimum fan run-time setting to prevent fan cycling.
- G. Variable frequency drives (VFD) shall be provided for the Makeup Air Unit and EF-1. The digital controller shall modulate the VFD between a minimum setpoint and a maximum setpoint on demand. The duct temperature sensor input(s) to the digital controller shall be used to calculate the speed reference signal.
- H. The VFD speed range of operation shall be from 0% to 100% for the system, with the actual minimum speed set as required to meet minimum ventilation requirements.
- I. An internal algorithm to the digital controller shall modulate supply fan VFD speed proportional to all exhaust fans that are located in the same fan group as the supply fan.
- J. The system shall operate in PREP MODE during light cooking load or COOL DOWN MODE when sufficient heat remains underneath the hood system after cooking operations have completed. Operation during either of these periods will disable the supply fan and provide an exhaust fan speed that is equal to the minimum ventilation requirement.
- K. A digital controller shall disable the supply fan, activate the exhaust fan, activate the appliance shunt trip, and disable an electric gas valve automatically when fire condition is detected on a covered hood.
- L. An LCD interface shall be provided with the following features:
  - 1. On/Off push button fan & light switch activation
  - 2. Integrated gas valve reset for electronic gas valves (no reset relay required)
  - 3. VFD Fault display with audible & visual alarm notification
  - 4. Duct temperature sensor failure detection with audible & visual alarm notification
  - 5. Mis-wired duct temperature sensor detection with audible & visual alarm notification
  - 6. A single low voltage Cat-5 RJ45 wiring connection
  - 7. An energy savings indicator that utilizes measured kWh from the VFDs
- M. Sequence of Operations:

The hood control panel shall be capable of operating in one or more of the following states at any given time:

- 1. Automatic: The system operates based on the differential between room temperature and the temperature at the hood cavity or exhaust duct collar. Fans activate at a configurable temperature differential threshold. Depending on the job configuration each fan zone can be configured as static or dynamic. These terms refer to whether a variable motor (such as EC Motors or VFD driven motors) modulate with temperature. If the panel is equipped with variable speed fans and the zone is defined as "dynamic", these will modulate within a user-defined range based on the temperature differential. Panels equipped with variable speed fans and a fan zone defined as "static", fans will run at a set speed calculated for the drive. Demand control ventilation systems are capable of modulating exhaust and make up air fan speeds per the requirements outlined in IECC 403.2.8.

2. Manual: The system operates based on human input from an HMI.
3. Schedule: A weekly schedule can be set to run fans for a specified period throughout the day. There are three occupied times per day to allow for the user to set up a time that is suitable to their needs. Any time that is within the defined occupied time, the system will run at modulation mode and follow the fan procedure algorithm based on temperature during this time. During unoccupied time, the system will have an extra offset to prevent unintended activation of the system during a time where the system is not being occupied.
4. Other: The system operates based on the input from an external source (DDC, BMS or hard-wired interlock)

2.14 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, and smoke dampers 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. 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.

<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
43 --> 60	20

Other:

Dishwash exhaust: 0.050 inch Aluminum with longitudinal seams

3. Methods of fabrication and installation shall be in strict accordance with guidelines set forth in the latest SMACNA Guide and Data Book for Low and Medium Pressure Duct Construction unless otherwise shown on drawings. Cross break all ducts with largest dimension being 18 inches and larger. Beaded ducts are not acceptable except for ductwork less than 18 inches in either direction.
4. All dampers and deflectors shall be a minimum of #22 gauge and stiffened as required. Splitter dampers shall not be acceptable.

5. All joints in ducts shall be made air tight, and all branches and turns shall be made with long radius elbows and fittings. Long radius elbows are defined as having a centerline radius of 1½ times the width of the duct.

If long radius elbows in square or rectangular ducts are not possible consult the Architect prior to continuing. Upon approve to use square elbows, 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. Unless specifically indicated not to, round ductwork may be substituted for rectangular if desired. The internal cross sectional area shall be not less then 95% of the cross sectional area of the rectangular duct it is replacing. 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 in all sizes shall be made with smooth (not segmented), long radius elbows and fittings. All seams shall be type RL-5, grooved seam pipe lock or better. *Lap seams are not permissible*. Gauge thicknesses shall be as outlined in SMACNA for galvanized steel round duct gauge selections for maximum 2 inches w.g. static pressure. Ductwork shall be supported with full wrap-around band and single hanger strap as indicated in Figure 4-4 of the 1985 edition of the SMACNA HVAC Duct Construction Standards handbook.
8. 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.
9. 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.
10. Testing, Balancing and Leak Testing... See Part 3, EXECUTION
11. Requirements set forth in applicable codes (see part one) shall supersede SMACNA standards.

#### C. Diffusers, Grilles and Registers

1. New grilles and/or registers shall be installed at all air supply, relief, return and exhaust openings as shown. All new units to be steel, 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 Titus 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). Anemostat, Krueger, Metalaire and Price only will also be considered for review.

- a. Exhaust Registers: 350RL with opposed blade damper and ¾ inch blade spacing, 35° front blade angle, front blades set horizontal.
- b. Return Grilles: 350RL without damper, ¾ inch blade spacing, 35° front blade angle, front blades set horizontal.
- c. Supply Grilles: 300RL, double deflection, ¾ inch blade spacing, front blades set horizontal.
- d. Supply Registers: 300RL, double deflection with opposed blade damper and ¾ inch blade spacing, front blades set horizontal.

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

2. New diffusers shall be installed at all air supply openings as shown. All units to be steel, except as noted, and provided with white baked enamel finish. The following list is based on model numbers of Titus to establish a standard of quality (if substituting, certified sound criteria shall be included with submittals indicating CFM and NC levels of each diffuser) or approved equal units by Anemostat, Krueger, Metalaire and Price only.

- a. Square face, 4 way discharge with circular duct connection, adjustable discharge pattern and removable core assembly. Model TMSA-AA for 24 inch x 24 inch lay-in application for suspended tile ceilings. Provide straightening grid for units in lay-in ceilings and combination butterfly damper and straightening grid for units in gypsum ceilings. 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. Duct Sleeves

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

#### E. Sealing of Ducts

All interior ductwork (except prefabricated grease ducts) shall be sealed with low VOC water based duct mastic, either "MP" (Multi-Purpose), Carlisle 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.

An approved alternative to mastic is VentureTape 1580 Mastiktape. Material shall be a printed 2.0 mil annealed aluminum foil coated with a heavy application of mastik adhesive. Material shall be UL181B-FX listed foil tape. Material shall span joints by not less than 1 inch on each side of the joint. It is acceptable to overlap by not less than ½ inch if wider applications are necessary. Ensure ductwork is clean of debris and dust prior to applying the tape. Duct tape in any other form or material is strictly prohibited.



F. 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. Doors accessing fire and smoke dampers shall be clearly marked, "FIRE DAMPER ACCESS", or "SMOKE DAMPER ACCESS" in block letters not less than ½ inch in height. Units to be Ruskin Model ADH-22 for rectangular duct and Model ADR for round duct or approved equal by Elmdor.

G. 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. Rods shall be keyed to prevent the handle from spinning on the rod.
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 with lockdown feature for all manual dampers (including bellmouth fittings), DuroDyne Model KS - Quadline or approved equal. Provide standoffs for round ducts.

H. Backdraft Dampers

Provide and install automatic counterbalanced backdraft dampers in air relief ducts, kitchen hood exhausts (in the fan curb) and where indicated on the drawings. Unit frames shall be channel type, constructed of 0.090 inch extruded aluminum. Blades shall be 0.025 inch formed aluminum with extruded vinyl edge seals. Unit shall employ aluminum blade linkage concealed in the frame and adjustable zinc plated counterbalance bar on blades (except on top blade). Units shall be capable of being mounted in any position, Ruskin Model CBD2 or approved equal. Contractor shall seal dampers to ductwork to provide a completely waterproof and airtight seal between damper frames and ductwork.

I. Smoke Dampers

1. Smoke dampers shall be installed to comply with NFPA 90A and 92A and U.L. standard UL555S, Sept. 1983 version. Provide an access door at each damper not accessible through grille.

2. All dampers to be provided by damper manufacturer with integral sleeves and mounting angles. Sleeves shall be either one piece, continuous with the dampers fitted inside or factory sealed joints to prevent air leakage. Models indicated are Ruskin to establish a standard:

- a. Wall type; Model SD35 Series, Leakage Class 3

3. Provide factory mounted electric, normally closed, 120 VAC actuator with each unit.
4. Installation shall be in accordance with damper manufacturer's instructions.

J. Roof Jack

1. Provide and install a roof jack for outdoor intake where show. Device shall be designed for use on flat roofs and include roof flashing pan not less than 16 inches square, tall cone flashing and a vent cap. Devices shall be 28 gauge galvanized steel for 7 inch ducts and 26 gauge for all others.
2. Master Flow "Versa-Cap" by GAF Industries Model 1200 or approved equal.

K. Kitchen Hood Grease Duct

1. Furnish and install as indicated on drawings, a double wall, insulated, pre-fabricated grease duct system complete with all required supports, braces, stiffeners and hangers. Inner wall shall be type 304 stainless steel, no less than 0.035 inches thick. The outer jacket shall be aluminized steel, no less than 0.025 inches thick. A minimum 1 inch ceramic insulation shall be provided between the outer and inner walls. System shall be UL-MH8251 listed and comply with NFPA 96-1994 Chapter 4. Shop drawings shall carry documentation of such.
2. System shall zero clearance, positively sealed.
3. Grease duct and accessories shall be Model IPIC, Series 1G by Metal-Fab, Inc. or Model IPS by Metalbestos. Systems shall be installed in strict accordance with the manufacturer's instructions and all applicable N.F.P.A., B.O.C.A. and local codes and ordinances.

L. 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.

M. Side Takeoff Fittings (for flexible duct)

Provide and install, at new flexible duct branches to diffusers, a bellmouth side takeoff fitting similar to detail on drawing M3, "*Flexible Duct and Diffuser Connection Detail*"; with manual damper. 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.

Units with manual dampers shall be heavy duty with bearings and hand quadrants. Fittings shall be anchored to ductwork with *not less than* three (3) screws. Final diameter shall be same size as diffuser served. Units shall be no thinner than 22 gauge, G-90 galvanized steel. Buckley Bellmouth HD-BM, HD-BMD or approved equal by Flexmaster or United Enertech.

N. 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.

- O. Wall caps shall be provided where indicated and shall include weather hoods extending to the bottom of the outlet. Units shall be 26 gauge (min) steel, primed for field painting and include a 0.020 inch damper with magnetic closure strips. Turn wall caps over to the General Contractor for finish painting prior to installation. All units for exhaust fans and range hoods shall be identical in appearance and shall be provided by Aldes Ventilation Corp. (<http://www.americanaldes.com>) 2000 Series or Artis Metals Company (<http://www.artiscaps.com/exhaust.html>). Wall caps provided with fans are not permissible unless they meet these design and construction standards.

## 2.15 FILTERS

New rooftop air handling unit shall be provided with a minimum of three (3) sets of filters with pleated media. 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 Architect). 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, 2 inches thick.

## 2.16 INSULATION AND CONDENSATE PROTECTION

A. General

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

B. Refrigerant Piping (see Part 4, "ALTERNATES")

1. New 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 1 inch.

2. Piping and fittings exposed to the elements shall have the insulation covered with ultraviolet resistant vinyl outdoor PVC jacket, JohnsManville Zeston 300 or approved equal.
3. Materials shall have a maximum thermal conductivity of 0.27 Btu-in./h-ft<sup>2</sup>-°F at a 75°F mean temperature when tested in accordance with ASTM C177 or ASTM C 518, latest revisions.
4. Materials shall have a maximum water vapor transmission of 0.08 perm inches when tested in accordance with ASTM E 96, Procedure A, latest revision.
5. Adhesive shall be the insulation manufacturer's recommended contact adhesive: Armaflex 520, Armaflex 520 BLV.
6. Accessories such as adhesives, mastics and cements shall have the same properties as listed above and shall not detract from any of the system ratings as specified above.

C. Duct and Equipment Insulation

1. New interior duct insulation shall be a ¾ pound density, all-service fiberglass duct wrap with factory applied foil faced FRK vapor barrier facing meeting the requirements of ASTM C 1136, Type II. Insulation material shall meet the requirements of NFPA 90A, NFPA 90B, ASTM C 1290 and ASTM C 553. Operating temperature range shall be from 40°F. to 250°F. Maximum “k” factor of 0.30 at 75°F. mean temperature difference. Owens Corning Type 75, Johns Manville Microlite XG or approved equal.
2. Insulate the following with 1½ inches installed thickness fiberglass duct wrap:
  - a. New heating & air conditioning supply air ducts (makeup air unit supply ducts need not be insulated).
3. Insulate the following with 3 inches installed thickness fiberglass duct wrap:
  - a. New outside air intake ducts from roof to connection to existing ducts.
  - b. All ducts (new and accessible existing) serving ceiling exhaust fans from exterior walls to 10 feet into the building.
4. Material to carry U. L. label. All laps to be sealed and held in place with adhesive and flare staples. All lap joints to be folded under before stapling so no raw insulation will be showing. On the bottom of ducts 24 inches or wider, mechanical fasteners shall be provided approximately 12 inches O.C.
5. Do not cover damper hand quadrants with insulation. Taper the insulation down to the devices and adhere the insulation to the ductwork.

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.

2.17 AUTOMATIC TEMPERATURE CONTROL (ATC)

A. General

1. Furnish and install a complete system of electric/electronic temperature controls.
2. The control system shall be manufactured and installed by either of the following vendors:
  - a. T.A.C.  
Maine Controls  
400 Presumpscot Street  
Portland, Maine 04103  
(207) 774-0220
  - b. Honeywell, Inc.  
501 County Road  
Westbrook, Maine 04092  
(207) 775-3501
  - c. Johnson Controls  
39 Salem Street  
P.O. Box 840  
Lynnfield, MA 01940  
1-800-288-1028, ext. 4478
  - d. Siemens Building Technologies  
66 Mussey Rd.  
Scarborough, Me. 04074  
(207) 885-4110
  - e. The Trane Company  
30 Thomas Drive  
Westbrook, Me. 04092  
(207) 828-1777
  - f. Automatic Logic, Inc.  
Wisdom Controls  
6 Cummings Rd.  
Scarborough, ME 04074  
(207) 899-5775
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.
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 control 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 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

Provide and install new low voltage temperature sensors for existing zone dampers where indicated and relocate existing setpoints where shown.

Install new thermostat for AH-1 (to be provided with the unit). See par. 2.07, "AIR HANDLER #1" for sequence of operation.

Make control connections to new compressor/condenser units under add Alternate #1.

Wire controls for kitchen grease hood and makeup air unit. See par. 2.13, "COOKING HOOD DEMAND CONTROL VENTILATION".

C. 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". See Part 1, Paragraph 1.03, sub-paragraph C, "MECHANICAL ELECTRICAL WORK" for specific requirements. Exception: Power wiring from circuit breaker to temperature control panel(s) will be provided and installed by the ATC Contractor.
2. ATC Contractor shall be responsible for coordinating installation of his wiring conduits with Division 26, "ELECTRICAL".

D. Submittal Brochure

The following shall be submitted for approval:

1. New control devices not provided with equipment.

E. Instruction and Adjustment

Upon completion of the project, after the ATC systems have been commissioned and are functioning as intended, the ATC Contractor shall:

1. Adjust for use by Owner, all thermostats, controllers, valves, damper operators, and relays provided under this section.
2. A competent technician who was involved in the actual installation of the ATC systems shall be provided to thoroughly instruct the Owner's Representative(s) in the care and operation of the ATC system. A representative of the Mechanical Contractor shall also be in attendance through all training. The total period of instruction shall not exceed one (1) hour. This instruction shall be in addition to instructions for equipment and systems not included in the ATC portion of this

project. See par. 3.09, "INSTRUCTIONS". Date and time of instruction shall be arranged with the Owner.

F. Guarantee

Control system components provided by the ATC Contractor 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.

G. 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.

## **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 new refrigerant piping, valves, and equipment shall be as indicated, or to meet requirements for complete installation.
2. Inspect each piece of pipe, tubing, fittings, and equipment for defects and obstructions; promptly remove all defective materials from the job site.
3. Maximum spacing of hangers for copper piping shall be as follows:

<u>Pipe Size</u>	<u>Spacing</u>
½", ¾" & 1"	6'-0"
1¼" & 1½"	6'-0"

#### B. Joints and Connections

1. Smoothly ream all cut pipe; cut all threads straight and true; apply best quality Teflon tape to all male pipe threads but not to inside of fittings; use graphite on all plugs.
2. All joints in refrigerant tubing shall be brazed.

#### C. Fire Safety

When soldering within 10 feet of combustible materials, fire extinguishing equipment shall be kept within 25 feet of work areas and clearly visible at all times. Contractor shall take additional measures when soldering close to wood structures to protect from ignition. Do not leave the work area unattended until materials being soldered have cooled to the touch.



### 3.03 PIPING TEST AND ADJUST

- A. During the installation all new refrigerant piping shall be tested with nitrogen to a pressure of not more than 125 psi and held for a period of not less than four (4) hours. Isolate devices not designed for this pressure. Any leaks shall be repaired and another test applied to the piping. All piping shall be tested before it is insulated or otherwise concealed. Contractor shall be required to certify in writing that piping has been tested and conforms to these requirements.
- B. After the installation is complete and ready for operation, the system shall be tested under normal operating conditions in the presence of the Architect and demonstrated that the system functions as designed.
- C. It shall be demonstrated that all parts of new refrigerant systems are tight. It shall also be demonstrated that all units are functioning properly and that control system operates correctly.
- D. Should any defects in operation develop during the test periods, the Mechanical Contractor will proceed to correct defects immediately. Additional tests will be conducted after correction.

### 3.04 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. Verify sizes and locations of all existing ductwork and equipment prior to commencement of work or purchase of materials and equipment.
- 2. Construction standards and sheet metal gauges shall be as outlined in the latest edition of the SMACNA HVAC Duct Construction Standards handbook for metal and flexible ducts unless specifically indicated otherwise.
- 3. Do not use segmented elbows or screws to connect fittings on clothes dryer ducts. Use smooth, long radius elbows and pop rivets instead.
- 4. Do not use square elbows for offsets that are show utilizing radius elbows (or partial radius elbows) without permission from the Architect.
- 5. 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.
  - d. Dampers are specified to be provided with locking hand quadrants. Do not cover the devices with insulation. Taper the insulation down to the devices and adhere the insulation to the ductwork.

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.

3.05 TESTING, ADJUSTING AND BALANCING (TAB)

A. General

1. TAB contractor shall be a subcontractor to the Mechanical Contractor.
2. The TAB Contractor must be NEBB certified and must provide, for review, contact information and copies of qualifications and certifications through the shop drawing review process. The following is a list of acceptable TAB contractors.
  - a. Central Air Balance
  - b. Maine Air Balance
  - c. Tab-Tech International
  - d. Tekon-Technical Consultants
  - e. Yankee Balancing

No others will be accepted unless pre-approved prior to opening of bids.

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

5. TAB Contractor shall submit field reports to Mechanical and General Contractors. Report defects and deficiencies noted during performance of services which prevent system testing and balance.
6. TAB contractor shall submit all verification and functional performance checklists/results, signed by indicated personnel, organized by system and sub-system.
7. TAB contractor shall submit other reports described below.

**B. Work Included**

1. Test, adjust and balance all air systems (new and existing) on the first floor, including components to conform to air and water 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 coil GPM's, air handling unit air volumes, etc. to the Testing and Balancing contractor at no cost to the contractor.
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 control sequences of operation. 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.

**D. Execution of TAB Work**

1. TAB Contractor shall visit job site and determine that control devices, test devices and valves are correctly installed and ready for balancing.

2. Examine each air distribution system to see that it is free from obstructions. Determine that all dampers and registers are in a set or full open position; that moving equipment is lubricated, and that required filters are clean and functioning. Request that Installing Contractor perform any adjustments necessary for proper functioning of the system.
3. TAB Contractor shall use test instruments that have been calibrated within a time period recommended by the manufacturer, and have been checked for accuracy prior to start of testing, adjusting and balancing activity.
4. Verify that all equipment performs as specified. Adjust variable type drives, volume dampers, control dampers, balancing valves and control valves as required by TAB work.
5. Test pressure profile of systems by traverse as required.
6. Adjust each register, diffuser terminal unit and damper to handle and properly distribute design airflow within 5% of specified quantities. Mark all setpoints.
7. Adjust front and rear discharge louvers on each supply register to distribute air in an even pattern or as indicated on plans. Adjust air discharge patterns of all supply air diffusers, registers and grilles for optimal air diffusion.
8. Document results of all testing on approved TAB report formats and submit 3 copies for approval and record within 15 days of completion of TAB work. Include a warranty period of 90 days, during which time the Architect and/or Engineer may request a re-check or re-adjustment of any part of the work.
9. Reports shall be compiled on a spreadsheet such as Excel, Quattro-Pro, Lotus, etc. and shall clearly indicate the following *minimum* information:
  - a. Air (Rated and Actual)
    - 1) System/unit name
    - 2) HP, BHP, voltage, amperage and fan rpm
    - 3) Static pressures; suction, discharge and total
    - 4) Total system flow rate
    - 5) Individual terminal flow rates (Terminal readings must show location, make, model and size of register, grille or diffuser).
    - 6) Provide a static pressure profile of all AHU's components in the two extreme operating modes; minimum outdoor air and economizer cycle.
    - 7) Filter status report
10. Reports shall 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. See par. 1.09, "ELECTRONIC DRAWINGS AND FILE SHARING" for additional information.

### 3.06 CLOSING IN UNINSPECTED WORK & ROUTINE INSPECTIONS

#### 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.

### 3.07 TEMPORARY HEATING

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

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

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

#### D. General Contractor will be required to assume full responsibility for the care and operation of the new equipment during its temporary use and to return the equipment to the Mechanical Contractor in perfect order, normal wear and tear excepted.

#### E. Water, fuel and electric power required to operate the heating system for temporary heat shall be provided by the General Contractor.

### 3.08 CLEANING

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

### 3.09 INSTRUCTIONS

On completion of the job, the Mechanical Contractor shall provide a competent technician to thoroughly instruct the Owner's Representative in the care and operation of the system. The total period of instruction shall not exceed twenty-four (24) hours. ATC system instruction shall be in addition to this instruction period. See 2.17, "AUTOMATIC TEMPERATURE CONTROL (ATC)", sub-par E, "Instruction and Adjustment". The time of instruction shall be arranged with the Owner.

### 3.10 REFRIGERANT PIPING (See Part 4, "ALTERNATES")

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 brazed. 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 2.02; "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.

### 3.11 REMOVAL OF EXISTING PIPING AND EQUIPMENT

- A. All piping and equipment indicated on the drawings for removal shall be done so by the Mechanical Contractor.
- B. All materials removed shall remain the property of the Owner until such time the Owner has reviewed the removed materials and either taken or designated items which he may wish to retain. The remainder shall become the property of this Mechanical Contractor and be removed from the premises immediately.
- C. Any damages done to removed materials prior to release by the Owner shall be corrected by the Mechanical Contractor at no additional expense to the Owner. Any materials removed prior to release by the Owner shall be replaced by the Mechanical Contractor at no additional expense to the Owner.

### 3.12 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.

### 3.13 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.

## **PART 4 - ALTERNATES**

### 4.01 GENERAL DESCRIPTION

- A. Alternate No. 1 is an add alternate to include replace existing Compressor/Condenser units ECC-2, ECC-3, ECC-4, ECC-5 and ECC-6.
- B. Work shall include:
1. Removal of existing compressor/condenser units
  2. Removal of existing evaporator coils
  3. Removal of existing refrigerant piping.
  4. Provide and install new compressor/condenser units, See par. 2.06, "COMPRESSOR/CONDENSER UNITS"
  5. Provide and install new evaporator coils, see par. 2.05, "DUCT COOLING COILS".
  6. Provide and install new refrigerant piping, see the following:
    - a) Par. 2.01, "PIPING"
    - b) Par. 2.02, "PIPE HANGERS AND SUPPORTS"
    - c) Par. 2.04, "REFRIGERANT SPECIALTIES"
    - d) Par. 2.16, "INSULATION AND CONDENSATE PROTECTION", sub-par. B, "Refrigerant Piping".
    - e) Par. 3.02, "INSTALLATION OF PIPING AND EQUIPMENT"
    - f) Par. 3.03, "PIPE TEST AND ADJUST"
  7. Connect existing control wiring to new units.
  8. Existing evaporator coils for ECC-2, ECC-3 and ECC-4 are "A" style for use in vertical ducts on top of existing upflow furnaces. Field verify dimensions.
  9. Existing evaporator coils for ECC-5 and ECC-6 are duct mounted for horizontal air flow. Field verify dimensions.
- C. If existing refrigerant piping is sized to meet the requirements of new equipment, it is acceptable to continue using it. Otherwise, remove unserviceable piping and insulation.

**END OF SECTION 23 00 00**



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