

**SECTION 230000****MECHANICAL DESIGN-ASSIST SPECIFICATIONS****PART 1 GENERAL****1.1 GENERAL**

A. See Section 010000 General for a summary of project scope and general requirements.

B. Design/Assist Approach

1. The work for this project will be built using a “design/assist” approach. The design/assist mechanical contractor (“Contractor”) and Taylor Engineering (“Engineer”) shall share design responsibilities as indicated herein.
2. The table below indicates engineering responsibility assignments for the Contractor and the Engineer.

<b>Item</b>	<b>Contractor</b>	<b>Engineer</b>
Engineer-of-Record	-	X
AC unit selection	S	P
Control systems	R	P
Construction details (see note below)	P	R
Completion of permit drawings	R	P
Submission of permit drawings for plan check and all permit handling	P	N
Title 24 and other code compliance documentation	R	P
Project construction management	P	N
Construction and all field work	P	R
Construction quality control	P	N
Start-up & TAB	P	R

3. Explanatory notes:
  - a. Primary (P) responsibility shall mean making all decisions and taking engineer/contractor-of-record responsibility for the item.
  - b. Secondary (S) responsibility shall mean taking an active role assisting the party with primary responsibility for the item.
  - c. Review (R) shall mean that the party shall review and comment on the work done by the party with primary responsibility for the item.
  - d. No (N) responsibility shall mean the party will have no role with regard to the item.
  - e. “Construction details” includes wall, roof, and floor penetration details, piping, ductwork, and equipment details and supports, vibration isolation details, housekeeping pad layouts and dimensioning, etc.

4. The Contractor shall be the engineer-of-record as well as the contractor of record and responsible for all required work.

## 1.2 PLAN CHECK, PERMITS AND FEES:

- A. Handle plan check submission process in concert with engineer of record.
- B. Provide all necessary notices, obtain all permits and pay all government taxes, and other costs in connection with this work.
- C. Obtain all required certificates of inspection for this work and deliver same to the Owner before request for acceptance and final payment for the work.

## 1.3 SUBMITTALS

- A. See Section 010000 for schedule and procedure.

### B. Contents of Submittals

#### 1. HVAC Equipment Submittals

- a. Manufacturer's name and model number
- b. All information required to completely describe materials and equipment and to indicate compliance with drawings and specifications, including, but not limited to:
  - 1) A schedule, for all items of the same type shall be supplied. The schedule shall include the manufacturer, the model, size, specific information that makes that item unique, the service of the item, the system served by the item.
  - 2) Physical Data, as applicable:
    - a) Dimensions
    - b) Weight
    - c) Finishes and colors
  - 3) Performance Data, as applicable:
    - a) Rated capacities
    - b) Performance curves
    - c) Operating temperature and pressure
  - 4) Electrical and plumbing requirements
  - 5) Flow and wiring diagrams as applicable
  - 6) Description of system operation

- c. All other pertinent information requested in individual paragraphs herein
- 2. Test, Adjust, and Balance (TAB) Submittal
  - a. All test and report forms that will be submitted for the final TAB report
  - b. A written description of the balance procedures
  - c. Submit at least 30 days prior to any TAB work.

C. Operating Instructions & Maintenance Manuals

- 1. Before requesting acceptance of work, submit in word-searchable format such as Adobe pdf via email for review by Engineer. File shall include bookmarks for each piece of equipment. Paper copies will not be accepted.
- 2. After review and making corrections noted, furnish three printed and bound sets for the Owner. Assemble in with separate tabs for each piece of equipment in heavy three-ring binder.
- 3. O&M manual shall include all submittal data submitted herein above, as installed. The intent of this section is that a single document contains all relevant information about each piece of equipment.
- 4. In addition to the submittal data, the O&M manual shall also include the following information:
  - a. Manufacturer's name, model number, service manual, spare-parts list, and descriptive literature for all components
  - b. Installation instructions
  - c. Maintenance instructions
  - d. Wiring diagrams
  - e. Listing of possible breakdown and repairs
  - f. Instruction for starting, operation and programming
  - g. Detailed and simplified one line, color coded flow and wiring diagram
  - h. Name, address and phone number of contractors equipment suppliers and service agencies
  - i. Guarantee period, including start and end period
  - j. Pre-functional test reports, dated and signed by testing technician
  - k. Start up test readings, dated and signed by testing technician
  - l. Test & Balance reports

D. Record Drawings

1. None required. By EOR.

1.4 COMPLETION REQUIREMENTS

- A. Until the documents required in this section are submitted and approved, the system will not be considered “accepted” and final payment to contractor will not be made.
- B. O&M Manual: See Paragraph 1.3C.
- C. Record Drawings: See Paragraph 1.3D.
- D. Test and Balance reports: See Paragraph 3.9
- E. Training: See Paragraph 3.10C
- F. Inspection and permit: Provide one copy of inspection certificates signed and approved by the local code authorities.
- G. Warranty: Provide written guarantee and warranty documents for all equipment and systems, including the start and end date for each.

1.5 SCHEDULE OF WORK

- A. See Section 010000 General.

1.6 GUARANTEE

- A. See Section 010000 General.

1.7 DESCRIPTION OF RETROFIT WORK

- A. See Section 010000 General for a summary of all work including demolition. This Section applies only to Mechanical (HVAC and Plumbing) new construction.
- B. New work:
  1. HVAC Work
    - a. Packaged heat pump and air conditioning rooftop units
      - 1) See Heat Pump and AC Unit Equipment Bid Package for reference.
      - 2) Install (4) new units on existing curbs using curb adapters.
      - 3) Connect AC units to existing rooftop supply and return ductwork using (N) flex connectors to account for misalignment if needed.
      - 4) Contractor is responsible for ensuring new AC unit’s supply and return openings align fully with existing conditions as part of AC unit submittal

coordination process. Modify existing ductwork if necessary to make unit connections.

2. Plumbing Work

- a. Provide condensate drain piping for all (4) AC units discharging to existing roofceptors.
- b. See alternate 1 in Division 1

3. Start-up, test, and balance

4. All other work required for a complete installation.

1.8 ALTERNATES AND UNIT PRICING

A. See Division 1

PART 2 MATERIALS

2.1 HEAT PUMP AND AC UNITS

1. See Heat Pump and AC Unit Specification Section 238119.

2.2 PIPING

A. Piping Materials

1. Condensate: Type L or M copper

B. Joint System:

1. Copper:
  - a. Hard temper
  - b. Wrought-copper, solder joint fittings, ANSI B16.22
  - c. 95/5 tin/antimony solder or silver hybrid

C. Exposed piping on the roof shall not interfere with access to any rooftop equipment.

2.3 DUCTWORK

A. Materials and joints:

1. Ductwork shall be G90 galvanized sheet metal
2. The gauge of metal, type of joints, hanging, reinforcing, and other details of construction shall conform to the SMACNA HVAC Duct Construction Standards.

3. Static pressure classes shall be as required by the fan system with the following:
  - a. AHU supply air: 3"
  - b. AHU return air: -1"
4. Joints
  - a. Rectangular Duct
    - 1) Longitudinal seams shall be Pittsburgh.
    - 2) Transverse Joints:
      - a) Medium pressure ductwork shall be TDC, TDF or Duct-Mate
  - b. Snap-lock joints not allowed

B. Duct Flexible Connectors

1. Duro Dyne Insulflex or equal
2. R = 4.2
3. Factory attached to 3" wide metal on both sides of flexible material.
4. Constructed in accordance with UL 181, Class I airduct with flanged connections.
5. Flexible, neoprene-coated glass fabric not lighter than 30 oz/sq. yd.

PART 3 EXECUTION

3.1 PROTECTION OF WORK DURING CONSTRUCTION

- A. Protect from damage, water, dust, etc., material, equipment and apparatus provided under this Division, both in storage and installed, until Notice of Completion has been filed.
- B. Provide protective covers, skids, plugs or caps to protect equipment and materials from damage and deterioration during construction. Protect exposed coils with plywood or other suitable rigid covers to avoid damage to fins.
- C. Protect existing walls, doors, carpeting, etc. from damage. Any damage must be repaired at no cost to Owner.
- D. Cover motors and other moving machinery to protect from dirt and water during construction.
- E. During transport to and storage on the construction site, and during rough-in until final connections are made, all ductwork and other related air distribution component openings shall be covered with plastic to prevent contamination from dust, water, and debris.
- F. Keep openings in piping closed to prevent entrance of foreign matter.

G. Material, Equipment or Apparatus:

1. Material, equipment or apparatus damaged because of improper storage or protection will be rejected.
2. Remove damaged material, equipment or apparatus from site and provide new, duplicate, material, equipment or apparatus in replacement of that rejected.
3. Porous materials, such as duct liner, shall be protected from weather. If such material becomes wet during construction, it shall be removed and replaced at no cost to Owner; drying is not sufficient due to possible microbial contamination.

3.2 INSTALLATION AND WORKMANSHIP

- A. All equipment and material shall be installed in a neat and workmanlike manner.
- B. Repair all damaged or temporarily removed walls, roofs, roofing, equipment, etc.
- C. Follow manufacturer's installation instructions and recommendations.
- D. All equipment must be anchored to the building. All hung equipment shall incorporate vibration isolation.
- E. When existing AC units are removed, confirm the presence of duct liner in the ductwork that goes down into the spaces.

3.3 PIPING

- A. Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently leak resistant piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes where indicated by use of reducing fittings. Align piping accurately at connections, within 1/16-inch misalignment tolerance.

3.4 DUCTWORK

- A. Install per SMACNA Standards.
- B. Rectangular and medium pressure duct bends greater than 45 degrees shall be curved sections, the center line radius of which shall not be less than 1-1/2 times the width of the duct in the plane of the bend. Where required due to space constraints, short radius elbows with duct splitter(s) may be used. No capped "bullhead" tees, and short-radius tees permitted. On low pressure ducts, square elbows with single width turning vanes may be used. Round duct elbows may be adjustable type on low pressure systems only, with gores sealed.
- C. Ductwork Sealing:
  1. Comply with:
    - a. Title 24 Energy Standards

- b. UL 181, 181A and 181B
- 2. ALL Ductwork shall be sealed per SMACNA sealing classes as follows:
  - a. Seal class A
  - b. Pressure applied tapes are not acceptable as the sole sealant.
  - c. Gasketed joints (e.g. TDC, TDF, and Duct-Mate) and longitudinal joints with sealant installed during fabrication do not require additional sealing.
- 3. Outdoor duct exposed to weather:
  - a. None.

### 3.5 SEISMIC CONTROL

- A. Install seismic restraints for pipes, ducts and equipment per CBC and SMACNA or Mason Industries Guidelines for pipe and duct bracing.
- B. Design and provide restraints to prevent permanent displacement in any direction caused by lateral motion, overturning, or uplift:
  - 1. Calculations required for supports and bracing for situations not covered by referenced guidelines.
  - 2. Include horizontal and vertical reaction loads at connections to building structures for all seismic restraints, including those covered by referenced guidelines. Coordinate reaction loads and attachment details with structural engineer for building.
  - 3. Calculations made and signed by registered structural engineer knowledgeable in seismic design:
    - a. Hired under this Section of work
    - b. Cost of calculations borne under this Section
- C. Provide resilient restraining devices as required to prevent equipment motion in excess of 1/4 inch
- D. Coordinate seismic bracing requirements with other sections to result in:
  - 1. Vertical pipe and duct restraints to coincide with and take place of required hangers
  - 2. Longitudinal pipe bracing to coincide with required pipe anchors
- E. Bracing shall not short circuit vibration isolation systems or transmit objectionable vibration or noise

### 3.6 CLEANING



- A. Thoroughly clean all equipment, ducts, etc. free of dust, scale, filings, plaster, grease, oil, paint and other construction debris.
- B. No construction materials, debris, dirt, etc. shall remain in any area, including both tenant areas and mechanical areas, during normal business hours. Clean up all areas prior to start of normal business hours.
- C. Ducts: Vacuum any visible debris from inside accessible ducts and plenums.

### 3.7 EQUIPMENT AND PIPING IDENTIFICATION

#### A. Equipment:

- 1. All mechanical equipment shall be identified by nameplates securely fastened in a clearly visible location to the equipment housing or frame. Nameplates shall include the equipment design plan mark. Provide additional nameplates on face of starters or variable speed drives.
- 2. Nameplates shall be 2-1/2" x 3/4" minimum, either 1/16" thick Bakelite with engraved white core letters and beveled edge, or aluminum with black enameled background and etched or engraved natural aluminum lettering.
- 3. Manufacturer's nameplate shall be clean and legible and installed in a clearly visible location.

### 3.8 LEAKAGE TESTING

- A. Duct leakage testing: Not required.

### 3.9 TESTING, ADJUSTING, AND BALANCING

- A. Testing and balancing shall be performed in complete accordance with AABC or NEBB National Standards for Field Measurements and Instrumentation as applicable to air distribution and hydronic systems.

#### B. VAV HP Packaged Unit

- 1. Supply fan maximum speed shall be set to the speed required to achieve scheduled design cfm.
  - a. Total supply air quantities shall be determined at all of the following where applicable
    - 1) Pitot traverse in the supply duct downstream, positive pressure side of the fan
    - 2) Pitot traverse at coil or filter bank
    - 3) Totalling the readings of individual air outlets
  - b. Outside air quantities shall be determined by all of the following where applicable

- 1) Pitot traverse of outside air intake louver/dampers
- 2) AFMS (if included)
2. Outside air flow measuring station calibration (if included)
  - a. Override the economizer to 100% outdoor air, i.e. configure the outdoor air damper to be 100% open and the return air damper to be 0% open.
  - b. Measure and report airflow and concurrent BAS AFMS readings at a minimum of three conditions
    - 1) Design airflow
    - 2) 50 percent of design airflow
    - 3) Minimum airflow
  - c. For factory calibrated AFMS: If measured airflow and BAS readings differ by more than 10%, consult with Owner's Representative for recalibration instructions. Do not change factory calibration without written direction.
  - d. For field calibrated AFMS: Coordinate with BAS installer to adjust calibration coefficients. Report coefficients in air balance report.
3. Design condition test
  - a. Test with system operating at design fan and minimum outside air flow conditions described above and report the following on a schematic of the system:
    - 1) Tags of all equipment
    - 2) Manufacturer and model of all fans and motors
    - 3) Motor horsepower, rpm, volts, phase, full load amps
    - 4) Sheave data at motor and fan; belt data
    - 5) Fan airflow rate at all locations measured, as listed above
    - 6) Final measured fan speed and amps
    - 7) Amps and kilowatts from variable speed drives
    - 8) Variable speed drive speed in hertz
    - 9) Static pressures measured at
      - a) Return air plenum
      - b) Downstream of return fan

- c) Mixed air plenum
- d) Downstream of filter
- e) Downstream of coil
- f) Discharge of supply fans
- g) At static pressure sensor
- 10) Concurrent fan data
  - a) Volts and amps input to variable speed drive
  - b) Amps and kilowatts from variable speed drive
  - c) Variable speed drive speed in hertz
  - d) Entering and leaving fan static pressure

#### C. CAV AC Unit

1. Total air quantities shall be obtained within 10 percent of design by adjustment of fan speed
  - a. Adjust sheaves on fans with adjustable sheaves.
  - b. Change sheaves on fans with fixed sheaves.
  - c. Adjust speed potentiometer for ECMs.
  - d. Adjust SCR for direct drive PSC motors.
2. Test and adjust minimum outside air flow
  - a. Supply air fan shall first be operating at design airflow.
  - b. Open return air damper fully.
  - c. Adjust the outdoor air damper signal through the BAS until the minimum outdoor airflow rate is achieved.
  - d. Convey this minimum signal to BAS installer and note on air balance report.
3. Test with system operating at minimum outside air flow condition described above and record the following on a schematic of the system
  - a. Tag
  - b. Manufacturer and model of fan and motor
  - c. Sheave data at motor and fan; belt data

- d. Motor horsepower, rpm, volts, phase, FLA
- e. Fan airflow rate at all locations measured, as listed above
- f. Final measured amps
- g. Static pressures measured at
  - 1) Return air plenum
  - 2) Mixed air plenum (for systems with outdoor air)
  - 3) Downstream of filter
  - 4) Downstream of coil
  - 5) Discharge of fans

D. Provide upon completion of tests a word-searchable pdf file of data listed above and below:

- 1. Name and address of testing agency and name of individual responsible for the work
- 2. Make, model and latest calibration date of testing equipment
- 3. Sketch or written description sufficient to identify individual devices tested

### 3.10 COMMISSIONING

A. The commissioning responsibilities of the HVAC Contractor are as follows:

- 1. Include requirements for submittal data, commissioning documentation, O&M data and training.
- 2. Assist and cooperate with the TAB contractor by putting all HVAC equipment and systems into operation and continuing the operation during each working day of TAB and commissioning, as required.
- 3. Develop and complete pre-functional checklists and submit for review.
- 4. Develop a full start-up and initial checkout plan and schedule using manufacturer's and specified start-up procedures for all commissioned equipment. Submit for review and approval prior to startup.
- 5. Provide skilled technicians to execute starting and pre-functional testing of equipment, and to assist in executing functional performance tests and interpret the data, as necessary. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
- 6. Provide approved T24 Part 6 Acceptance Test Technicians and complete code required acceptance testing.

7. Prepare an outline and schedule for training programs for approval.
8. Include start up, pre-functional, acceptance test, and functional test documentation in the Operations and Maintenance Manual.

B. Controls Commissioning. See Section 250000 BAS.

C. Training

1. General Training: Upon completion of work, provide Owner's operating personnel two instruction periods in operation and maintenance of material and equipment. Each period shall be 3-hours continuous; first period to be immediately upon completion, and second period within 30 days of completion.
2. Control System Training: See Section 250000 BAS.

END OF SECTION