

23 09 93.11 SEQUENCES OF OPERATION

1. ALL SYSTEMS
 - A. **Dead Bands:** Where used to control both heating and cooling, automatic changeover zone thermostatic controls shall be capable of providing a temperature range or dead band of at least 5°F within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum. Exceptions: Special applications where wide temperature ranges are not acceptable (retirement homes, data processing, museums, and or varied hospital areas) and are approved by the authority having jurisdiction.
 - B. **Automatic Shutdown.** Each HVAC system shall have controls that can start and stop the system under different time schedules for seven different daytypes per week, are capable of retaining programming and time setting during loss of power for a period of at least 10 hours, and include an accessible manual override, or equivalent function, that allows temporary operation of the system for up to two hours.
 - C. **Setback Controls.** Heating systems have the capability to automatically restart and temporarily operate the system to maintain zone temperatures above a heating setpoint adjustable down to 55°F or lower. Cooling systems shall have the capability to automatically restart and temporarily operate the system as required to maintain zone temperatures below a cooling setpoint adjustable up to 85°F or higher or to prevent high space humidity levels.
 - D. **Gravity Hoods, Vents, and Ventilators.** All outdoor air supply and exhaust hoods, vents, and ventilators shall have motorized dampers that automatically shut when the spaces served are not in use.
 - E. **Shutoff Damper Controls.** Both outdoor air supply and exhaust systems shall be equipped with motorized dampers that automatically shut when the systems or spaces served are not in use. Ventilation outdoor air dampers shall automatically shut off during preoccupancy building warm-up, cool down, and setback. Exceptions:
 - a. Gravity (non-motorized) dampers are acceptable in exhaust systems in ASHRAE 90.1 2007 climate zones 1, 2, 3.
 - b. Gravity (non-motorized) dampers are acceptable in systems with a design outdoor air intake or exhaust capacity of 300 cfm or less.
 - F. **Adjustments to sequences of operation.** Make programming, set point, and other changes to the Sequences of Operation as directed by Engineer as a result of submittal/ shop drawing review, commissioning activities or issues discovered during the warranty period.
2. SINGLE ZONE CONSTANT VOLUME A/C SPLIT SYSTEM:
 - A. Programmable thermostat controls system off/on cycles; multiple cycles per day. When system is on, fan runs continuously. Fan is to only run when the compressor is running.
 - B. Zone thermostat cycles compressor(s) and activates indoor fan, during cooling mode. Upon a call for heating, the indoor fan and the heating coil shall be activated to maintain setpoint.
 - C. Thermostat or space sensor shall measure temperature in space (as indicated on plans). If space sensor is shown, space sensor shall relay temperature to zone controller located in staff area.

23 23 00 REFRIGERANT PIPING AND SPECIALTIES

Size per A/C unit manufacturer's requirements in the engineered reviewed equipment submittal(s), including requirement for long line applications. Provide solenoid valves, traps and/or accumulator when recommended by condensing unit vendor, such as for underground lines. Provide dedicated set of refrigerant piping for each refrigerant circuit. Use factory sealed line sets, unless size or distance exceeds factory set availability. Route hidden from view. Insulate suction line. Insulate liquid lines when required by manufacturer. Seal wall penetrations.

Copper Tubing: ASTM B280, Type ACR hard drawn or annealed. Fittings: ASME B16.22 wrought copper. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F. Unions, flanges, and couplings: copper pipe: bronze, soldered joints.

Below-ground copper tubing when allowed by system manufacturer shall be 7/8 inch OD: ASTM B88, Type K, annealed. Fittings: ASME B16.26 cast copper, compression type. Joints: Flared. All lines shall be run with insulation and be installed in a PVC conduit that is watertight. At a minimum, all buried refrigerant lines shall be below the frost line.

Aluminum piping is prohibited.

23 31 00 HVAC DUCTS

Do not fabricate duct from these drawings, confirm all dimensions and available space in field. Dimensions given on drawings are inside free area, sheet metal is larger on lined duct. Branch takeoffs to have 45 degree entry fitting with volume damper. Elbows to be radius type with minimum centerline radius 1.5 times width or mitered elbows with single thickness turning vanes.

Sheet metal: Use galvanized sheet metal, conforming to current SMACNA for construction, reinforcing, support and other aspects.

PRESSURE CLASS:
Supply from single zone units: +1"
Return: -1"
Exhaust: -1" upstream of fan, 1" downstream

DUCT SEALING:

Definitions (per ASHRAE SYSTEMS & EQUIPMENT 2008 TABLE 18-1):
Seal Level A: All transverse joints and longitudinal seams, and all duct wall penetrations
Seal Level B: All transverse joints and longitudinal seams
Round or flat oval spiral seams need not be sealed
Transverse joints include connections (including but not limited to spin-ins, taps, branches, access door frames, duct connections to equipment)
Duct wall penetrations include but are not limited to screws, pipe, tubes, rods, wires & non self-sealing fasteners

Supply and outside air ducts, all locations: Seal Level A.
Return or exhaust ducts: Seal Level B
Seal all metal ducts using Hardcast or equal mastic plus fiberglass scrim.

Sealant: Foster 32-19 or Childers CP-146. Do not use oil or solvent base sealants inside buildings. Do not exceed LEED/SCAQMD volatile organic compound limits inside buildings. Tape sealants are not allowed
Externally insulated ducts shall be sealed before being insulated. Sealants of exterior ducts shall form a water and air-tight seal, bond to the metal involved, remain flexible with metal movement and have a service temperature range of -30°F to +175°F. If exposed to direct sunlight, sealant shall be UV and ozone resistant. Foster 32-19 or Childers CP-146.

DUCT LINER / INSULATION SCHEDULE:

- Rectangular supply; Unlined, externally insulated, except that 25 feet closest to fan or air units shall be internally lined
- Round supply; Unlined, externally insulated
- Return duct- Internal liner
- Exhaust- No liner, no insulation; except that exhaust ducts in non-conditioned attics shall be externally insulated
- Outside air – Unlined, externally insulated, except that 15 feet closest to a fan shall be internally lined. Ductwork upstream and downstream on humidifier up to the fan shall remain unlined if humidifier (manifold) is present.

Kitchen or food preparation area supply ducts – unlined, externally insulated

Liner (when specified in duct description above): *Schuller Permacote Linacoustic; Certainteed Tough Gard or equal*, 1.5 PCF (pounds per cubic foot) density, coated fiberglass conforming to ASTM C1071; coating to be cleanable and shall prevent microbial growth per ASTM G21, G22. Attached with adhesive (Foster 85-60, Childers CP-127, or equivalent) with 90% coverage and stick clips. Meet minimum noise reduction Standard of ASTM C1071. Leading edges and transverse joints to be sealed, Foster 81-42W (white), CP-50AMV1 (white), CP-135 (black), or equivalent.

Liner R-values shall meet duct insulation values spec'd in section 23 07 03. In addition to meeting R-values, the following minimum thicknesses shall be maintained for acoustic reasons: Supply duct: 1". Return ducts: 1/2" except that within 15 feet of fan or air unit use 1". Return air sound traps: 1".

Flex duct

Shall not exceed 5 feet in length, nor be bent more than 90 degrees. Flex duct shall be same size as diffuser neck. Flexmaster 5B, 5M, 6B, 6M, 8B, 8M or eq. Nylon, CPE or foil/fiberglass/polyester laminate, supported by helically wound spring steel wire; fiberglass insulation; vapor barrier film. Product shall have listed marks by either ETL, or UL and shall have minimum 25/50 Flame/Smoke ratings. Pressure Rating: 6-inches WG positive; 1-inch WG negative. Vapor barrier Perm rating of 0.10 or less per ASTM E96 procedure A. Insulation: R value to meet that required for ductwork. Inner core shall maintain shape and full free area at 90 degree bends without glues or reinforcement.

Grease exhaust duct from cooking hoods

Liquid tight, welded 16-gage steel or 18 gage stainless. Duct sloped toward hood minimum 1/4 inch per linear foot (1" per foot if horizontal length exceeds 75 ft). Minimum 1500 fpm velocity; maximum 2500 fpm. Confirm location and size of hood connections- See Food Service equipment plans. Access cleanouts doors in changes of direction. UL listed or matching duct construction. In duct side or top (not bottom) and at all changes of direction. Within 18 inches of hood collar when hood has dampers. On both sides of inline fans. On horizontal ducts: 20 x20 for personnel entry; when 20x20 is not possible, provide access panels every 12 feet. Signage on panels: "ACCESS PANEL- DO NOT OBSTRUCT"

Field fabricated ducts: Liquid tight, welded 16-gage steel or 18 gage stainless. Enclose portion of duct from ceiling penetration to or thru roof with 2-hour, UL 1978 classified wrap system *3M FireBarrier Duct Wrap 15A or equal*. Installation, supports, access panel insulation per manufacturer's instructions. Grease duct enclosure systems shall be tested to UL 2221. Enclosures shall be vented to building exterior. Outdoor ducts shall be painted for weather protection, unless stainless steel.

DOMESTIC DRIER VENTS

Use 4" minimum diameter rigid metal duct with smooth interior surface. Do not use sheet metal screws or other fasteners which obstruct the air flow. Flexible all metal duct allowed only where field conditions prohibit rigid; use of flex must be specifically approved by Owner for each circumstance. Transitions between drier and wall connection shall be aluminum flex or GE WX8X73 Supurr-FLEX. Wall caps shall be 4" opening and be equal to GE WX8X59 and shall have a backdraft damper. Outlets shall point down and shall be a minimum 12" above the ground or any other obstructions.

23 33 00 AIR DUCT ACCESSORIES

Provide manual balancing dampers in all supply and exhaust branches. Provide manual balancing dampers in outside air and return ducts to each air unit. Provide manual balancing damper at each motorized duct damper location.

VOLUME CONTROL DAMPERS: per SMACNA HVAC Duct Construction Standards - Metal and Flexible. Single blade dampers for duct sizes up to 6 x 30 inch. Multi-Blade Damper: opposed blade pattern. Assemble center and edge crimped blades in prime coated or galvanized frame channel with suitable hardware. Except in round ductwork 12 inches and smaller, furnish end bearings. Furnish closed end bearings on ducts having pressure classification over 2 inches wg.

Furnish locking, indicating quadrant regulators on single and multi-blade dampers. On insulated ducts mount quadrant regulators on standoff mounting brackets, bases, or adapters to allow full insulation thickness. Where rod lengths exceed 30 inches furnish regulator at both ends.

All balance damper operators shall be accessible via access panel, lay-in ceiling or remote cable operator. All motorized damper operators shall be accessible and shall not block the air stream.

Outdoor air, supply and exhaust air dampers shall have a maximum leakage rate of 0.3 cfm per square foot.

BACKDRAFT DAMPERS: Parallel-action, gravity-balanced, galv. 16 gage thick steel or extruded aluminum blades with felt or flexible vinyl sealed edges. Blades linked together in rattle-free manner with 90-degree stop, steel ball bearings, and plated steel pivot pin. Adjustment device to permit setting for varying differential static pressure.

DUCT ACCESS DOORS: per SMACNA, rigid and close fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, furnish same insulating value as adjacent duct, plus sheet metal cover. Less than 12 inches sq., secure with sash locks. Up to 18 inches sq.; two hinges and two sash locks. Up to 24 x 48 inches: Three hinges and two compression latches. Access panels with sheet metal screw fasteners or requiring use of tools are not acceptable. Stencil or label fire and smoke damper access doors per local requirements

FLEXIBLE CONNECTIONS: per SMACNA. Fabric crimped into 24 gage galvanized metal edging strip. Fabric: Approx. 3 inches wide. UL listed fire-retardant neoprene coated woven glass fiber fabric conforming to NFPA 90A.

DUCT TEST HOLES: air tight flanged fittings with screw cap. Furnish extended neck fittings to clear insulation.

23 37 13 AIR INLETS AND OUTLETS

For air devices located in lay-in ceilings, vendor shall confirm ceiling grid type and size prior to ordering air devices. Acceptable Manufacturers: Titus, Price, MetalAire, Nailor, Kreuger

SIDEWALL AIR DEVICES

Sidewall supply- double deflection, 3/4" spacing, front blades vertical, opposed blade damper Titus *300 R or equal*
Wall return grille: steel or aluminum, white, 35 deg horizontal louvers on 3/4" spacing. Opposed blade damper. *Titus 350 RL or equal*

23 41 00 HVAC AIR CLEANING DEVICES

Filters shall be 2", 30 percent efficiency as per ASHRAE 52.2 -2017. Maximum initial resistance at 500 fpm = 0.25". *AAF 'Perfect Pleat HC M8'* or equal. Use standard sizes only.

Provide construction filters for the duration of this project in all air units serving the project area.

Replace with new filters after balancing and adjusting is complete. Provide temporary filter media over all return or exhaust grilles in project area, to keep construction dust out of air systems.

23 54 16.13 GAS FURNACES WITH DX COILS

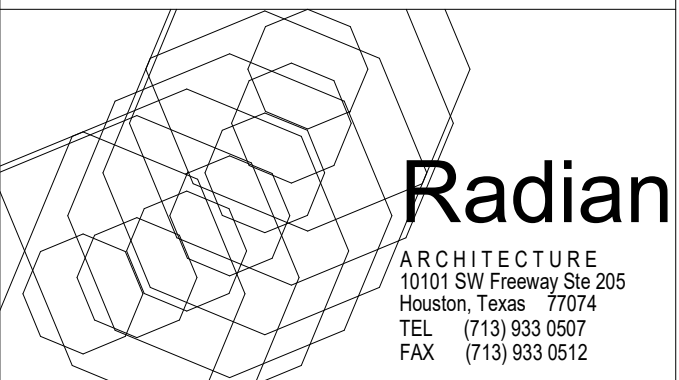
Horizontal or vertical as shown on drawings. AGA certified. Automatic electronic pilot. Route condensate drain (provide 3" deep trap) to floor or hub drain provided by plumber. Install with manufacturer's required clearances to combustibles. Provide overflow pan for attic units, with discharge to drip through soffit. Provide type B flue through roof to Breidert cap. Gas piping is by Plumber.

23 81 26 SPLIT-SYSTEM AIR-CONDITIONERS

DX FAN COIL UNITS: Factory painted galvanized steel, insulated casing; sloped drain pan; filter rack; multispeed blower, control transformer, supply and return duct flanges, copper coil/aluminum fins, and manufacturer's standard expansion valve or metering device. Coil factory matched to condensing unit.

AIR COOLED CONDENSING UNITS: UL or CSA listed and ARI certified. Copper tube, aluminium fin coils. Provide with crankcase heaters, overload protection, time delay relay, filter drier, sight glass, and anti-short cycle relay. All units larger than 10 tons shall be provided with dual compressors.

**OPTIMUM CARE
SUGAR LAND, TEXAS**



Revision Schedule

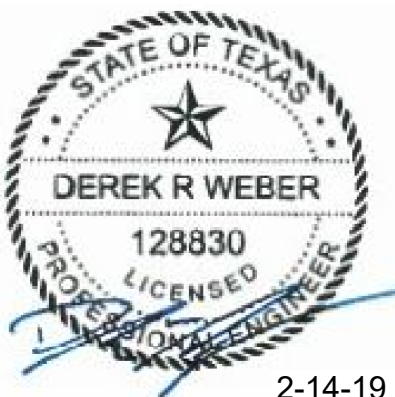
#	Date	Description
	10-26-18	PERMIT, PRICING, AND CONSTRUCTION
	02-14-19	City Comments

Project No.

MECHANICAL SPECS

Sheet No.

M3.2



2-14-19

