Facility Design Guidelines: Workplace, Architecture & Engineering

Air Handling Units
MasterFormat Section 23-73-23

The guidelines described herein shall be used on all projects, unless USAA’s Project Variance Request process has been used to secure an approved, project-specific variance.

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>11/31/2017</td>
<td>Issued</td>
</tr>
<tr>
<td>01</td>
<td>12/22/2018</td>
<td>Revised to include M &amp; O requirement</td>
</tr>
<tr>
<td>02</td>
<td>6/30/2020</td>
<td>Revised format for upload to USAA.com</td>
</tr>
</tbody>
</table>

1.0 GENERAL

A. The A/E is fully responsible for the mechanical design. The following is a guide to the minimum design analysis required at the earliest possible stage in design.

B. For new construction and where economical on remodels; Dedicated Outside Air Systems (DOAS) with energy recovery must be considered.

C. The design team must evaluate methods to ensure occupant comfort at levels equal to or better than ASHRAE 55 (current version).

D. The design team must perform calculations to verify that the predicted percent dissatisfied (PPD) will be 10% or less, which is more stringent that the 20% or less called for by the guideline.

E. Design team should first develop the Basis of Design (BOD) documents which call out the ventilation, heating and cooling requirements for the project and include “process flow diagrams” that detail major pieces of equipment, air flow, temperature and humidity requirements. The BOD must be updated periodically through the design process as the design becomes more detailed.

F. Design team must develop a diagrammatic Sequence of Operations (SoO) in flowchart format (or similar).

G. The design team must take great care in verifying that the controls submittals conform to the design intent.

H. The commissioning agent must verify that the installed system performs per the design intent.

I. Provide submittals that indicates dimensions, weights, capacities, ratings, fan performance, gages, electrical characteristics, connection requirements and finishes of materials.

J. Units must be double wall and the use of fan wall technology with ECM motors is greatly desired.

K. Drain pans must be stainless-steel, single piece construction and insulated under the pan.

L. Units must be rated and certified under ARI standard 430 and 410, current edition.

M. All capacities of equipment must be shown accurately on schedules on the drawings to include motor and starter characteristics.

N. Filtration for occupied spaces shall be electrostatic MERV 14 filters, gasketed.
O. Provide data of filter media, filter performance data, filter assembly, and filter frames as tested and certified per ASHRAE 52.2 and UL-900 class 1.

P. Provide fan curves with specified operating point clearly plotted, as tested and certified per AMCA standards (refer to fan array section for AMCA requirements on fan arrays).

Q. Submit sound power level data for both fan outlet and casing radiation at rated capacity, as tested and certified per AMCA and ARI 260 standards.

R. Provide data on all coils as tested and certified per ARI standards.

S. Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating field installed wiring.

T. All electrical power, lighting, control, sensor, pressure taps, and TAB access ports must be noted on the submittal drawings.

1.1 MANUFACTURERS
A. Allowable Air Handler Units manufactures:
   1. Climate Craft
   2. Haakon
   3. Temtrol
   4. Governaire
   5. Air Enterprises
   6. Thermal Corporation

1.2 OPERATION AND MAINTENANCE DATA:
   1. Include instructions for lubrication, filter replacement, motor replacement, drive replacement, recommended spare parts lists, and wiring diagrams that are specific to the unit installed.
   2. Provide operations and maintenance (O&M) manuals for air handling units.
   3. Provide manufacturers start-up information and maintenance required prior to Start-up.

1.3 CONSTRUCTION FILTER MEDIA CHANGE OUT PROCESS:
A. First set of filters is to be installed prior to when unit is first started up to protect unit from construction debris. Replace first set of filters with a second set of filters when test and balance activities begin. CxA must verify that the second set of filters was installed prior to T&B activities begin. At substantial completion, CxA must inspect filters to determine if a third set should be installed.

1.4 AIR HANDLER CASING AND GENERAL CONSTRUCTION:
A. Unit exterior casing walls and roof must be a minimum 18-gauge thickness galvanized steel insulated internally, throughout (double wall construction with no through metal).
B. Internal insulation must have an R-10 rating and all internal insulation must be protected with solid galvanized sheet metal, of a minimum of 20-gauge thickness. All sheet metal joints throughout the air handler, and between panelized sections, must be gasketed soft rubber gaskets, fabricated from EPDM, or other approved material. Internal walls and roof outside must be sealed so there is no leakage of air from inside the unit to the outer casing.
C. The casing shall incorporate insulating thermal breaks as required so that, when fully assembled, there’s no path of continuous unbroken metal to metal conduction from inner to outer surfaces.

D. Drain pan liners must be constructed of 14-gauge 316-L stainless steel or heavier as standard with the manufacturer and must be non-skid. Drain pan must extend past the cooling coil in the direction of airflow by a minimum of 18”. Entire drain pan must be insulated with R-8 rigid insulation. Drain pans must be sloped to the outside edge of the unit. On units over six feet wide, slope to each side of the unit.

E. Unit must have a complete perimeter channel base of at least 6” galvanized steel or 6” carbon steel with marine quality primer.

F. All floors must be insulated with R-10 insulation with 14-gauge non-skid galvanized floor (or equivalent aluminum).

G. Access doors must be provided to allow access upstream and downstream of the filter racks on both sides of the unit.

H. The fan section, and coils and be large enough to allow removal of fans without cutting the fan or base into pieces.

I. Access doors must be double wall, insulated the same as wall panels, and the opening framed with thermal break construction. Door size must be at least 18” wide and full height of the panel.

J. Each access door must have a minimum of an 8” by 6” double-glazed view window, capable of withstanding the total developed pressure of the unit. The doors must be hinged using either heavy-duty stainless hinges, or a continuous stainless steel piano hinge, extending along the entire edge of the door, except for a maximum of two inches at each end and three latches in doors over 36” long. All access doors must open against air pressure.

K. Coils in the air-handling units must be individually removable and must not be used to provide structural stability for the casing. All coils must be arranged for and piped to provide counterflow operation. All coil frames must be fabricated of 316 L stainless steel. The coils must be completely enclosed within the coil housing of the air unit casing.

L. All penetrations of the air handler casing must be sealed.

M. Stacked coils must have intermediate drain pans extending no less than 12” in the direction of airflow with at least 1” rigid drain piping and pipe supports to main drain pan. Stacked coils must be constructed with a blank off plate between upper and lower coils to eliminate coil bypass air from contacting intermediate drain pan.

N. Panels must be reinforced with sufficient internal bracing to prevent excessive deflection of the panels.

O. Panel construction must provide the following acoustical performance.
   1. Sound Transmission Loss (dB) per ASTM E-90 & E-4130
   2. Sound Absorption Coefficients per ASTM C-423 & E-795.
   3. Unit manufacturer must submit full sound performance.

P. Unit housing, including joints, seams, and access doors, must not condense moisture on the external surfaces of the housing when subjected to a surrounding ambient environment of 82°F dry-bulb/75°F dew-point temperature air with chilled water temperatures of 40°F and a discharge air temperature of 50°F.

Q. Provide sealable test ports on either side of each filter bank and each coil section, in inlet plenum and discharge plenum, and suction and discharge side of all fans.
1.5  FANS  
A. Must be both dynamically and statically balanced. Housed fans must be equipped with quick opening access doors in the fan scroll. The motor mounting for each unit must be an integral part of the fan support frame.  
B. The unit must be supplied with a factory installed and sealed flange for connection to ductwork.  
C. The fan unit bearings must be of the antifriction type, either ball or roller, lubricated at the factory, and must be equipped with means for lubrication with a grease fitting on the outside of the bearing housing. Both inboard and outboard bearings must be the same, identical size.  
D. Fan bearings must have an L-10 minimum life of 200,000 hours. Intermediate bearings will not be acceptable.  
E. Grease fittings for fan bearings must be mounted where it is most easily accessible for service. The tubing used for remoting the fitting must be stainless steel, installed with a strain relief pigtail approximately 4 inches in diameter and located on the drive side of the assembly.  
F. After assembly, the unit manufacturer must balance the fan (per ANSI/AMCA 204-96 fan application category BV-3) at design fan speed with belts and drives in place to a vibration velocity less than or equal to 0.157 inches (0.100 inches for direct-drive applications) per second measured on horizontal, vertical, and axial planes at each bearing pad. Vibration amplitudes are in inches/second peak velocity. All values recorded are to be filter-in at the fan speed.  
G. Plug fans installed in walk-in units must be provided with a safety cage around the wheel or with a fan shut down switch in the access door. Cage must be large enough to allow working room for wheel and bearing service and must have removable sections to allow wheel removal.

1.6  MULTIPLE FANS  
A. Multiple fans must comprise the scheduled number of fans each rated for equal flow and static pressure. Fans must be selected for N redundancy where noted on the schedule.  
B. Multiple fans will be furnished with unit mounted panel that provides separate on/off relays, disconnect, and thermal overload connection for each fan in the array.  
C. Each fan must be furnished with a backdraft damper to prevent recirculation through inactive fans. The performance effect of this damper must be included in the performance of the fan.  
D. Each fan will be provided with a fan status Outputs integration with the Building Automation System.  
E. Each fan/motor assembly shall be dynamically balanced to meet AMCA standard 204-96, exceeding category BV-5, to meet or exceed an equivalent Grade G.55, producing a maximum rotational imbalance of .022” per second peak, filter in (0.55mm per second peak, filter in).  
F. There shall be no blank off plates or “spacers” between adjacent fan columns or rows to position the fans across the air way tunnel.  
G. the multiple fan arrays shall be provided with an integral back flow prevention device that prohibits recirculation of air in the event a fan or multiple fans become disabled.  
H. Each fan motor must be independently grounded. Common or ungrounded motors will not be accepted.  
I. Total brake horsepower must be selected within 5% of maximum brake horsepower scheduled.  
J. FAN WHEEL AND HOUSINGS IN TAMPA or any other COASTAL AREA must be HOT DIP GALVANIZED OR COATED WITH ZINCILATE.
1.7 DAMPERS
A. All automatic control dampers and manual volume control dampers located within the air handling unit or at the air opening on the air handling unit must be furnished by AHU manufacturer.
   1. The actuators for the dampers must be furnished by the Building Automation Contractor.
B. Backdraft damper must allow for the re-start of a de-activated fan while the unit is running without back-spinning the fan and causing a VFD fault. If backdraft damper cannot achieve a running start through pressure differential, AHU manufacturer shall provide a control system/actuators/sensors to allow VFD motor start while the rest of the fan array is running at full airflow.

1.8 ELECTRICAL
A. Fan motors must be interlocked with fan access door to shut down when door is opened.
B. Fan motors must be factory mounted and wired to an external disconnect switch adjacent to the motor access door.
C. Vapor proof lights (ceiling or wall mounted so that fixture must be no higher than 88” above floor) must be provided in each compartment with access doors.
D. Lights must have a switch at each door into the compartment.
E. Provide two GFI convenience outlets evenly spaced on the long dimension of the unit. Wire lights and outlets to two external 120v, 20a power connections (one for each service) for connection by Division 26.
F. All wiring must be 600v rated type MTW/THWN stranded copper in EMT or LiquidTite conduit (max 3 feet). All junction boxes must be UL approved and gasketed.

1.9 INSTALLATION
A. Field assembly of the unit must be the responsibility of the manufacturer.
B. Install in conformance with ARI 435.
   1. Assemble high-pressure units by bolting sections together. Isolate fan section with flexible duct connections for units equipped with housed fans
   2. Unit must be installed level and plumb. Where units are installed on a concrete housekeeping pad, units must be installed on neoprene pads as indicated on installation details and in Section 23 05 48 - Vibration Isolation.
   3. Piping and duct connections must be installed so that all access doors swing freely.

1.10 TESTING
A. Units with cabinet mounted fans must be tested and certified at rated conditions using AMCA 210 and AMCA 300 test procedures with fan mounted in the cabinet. Bare fan data will not be accepted.
B. Casing Deflection Test
   1. Deflection limit of L/250 must be demonstrated in the factory prior to shipping.
C. Casing Leakage Test. With unit set in place, leveled and ready to receive duct work connections after delivery on-site, unit must be tested for casing leakage by sealing all openings and pressurizing to 2.5 times rated pressure (defined as total static pressure of unit) or 10” WG, whichever is smaller. Maximum allowable leakage rate is 1.5% of rated unit flow.
Test is to be performed using flow measurement devices and must be witnessed by a representative of the Owner’s CxA.

D. Fan/Motor Vibration Test. With the unit set in place, leveled, and ductwork attached, the manufacturer must perform a final dynamic vibration trim balance to verify the fan/motor vibration velocity limit over the following operating speed range: Fans with VFDs must be checked by operating at VFD speeds from 20 to 65 Hz. Constant speed fans must be checked at 100% of rated fan speed. ‘Lock-out’ ranges may be used to correct up to three ranges of excess vibration. The span of each ‘lock-out’ range must be limited to an effective fan speed of 50 RPM. Any ‘lock-out’ range used must be clearly identified in the test report and must be prominently displayed on a typed, laminated legend mounted inside the VFD controller cabinet. This testing must be witnessed by the Owner’s CxA.

E. Air handling units equipped with multiple fans; each fan must be tested individually and the fan array must be tested as an assembly.

F. Failure of the leakage and/or deflection test must require sealing and bracing of the unit and retesting until criteria is met.

G. Failure of the trim balance to confirm vibration limit must require rebalancing and re-tested.

1.11 FINAL CLEANING AND PREPARATION

A. Prior to substantial completion, contractor must:
   1. Wipe down and clean the unit inside and outside.
   2. All coils must be combed to straighten any bent fins.
   3. Filters that were used in the construction phase must be replaced with new filters.
   4. All penetrations made in the unit cabinet (power, controls, tab, etc.) must be sealed air tight.

END OF SECTION