

**SECTION 233416 – FANS**

- 1.0 ASHRAE 90.1 Compliance: University of Pennsylvania buildings shall comply with the Commercial Energy Efficiency Requirements of ASHRAE Standard 90.1-2016. The ASHRAE 90.1-2016 compliance paths shall be followed instead of the International Energy Conservation Code (IECC) requirements as permitted by 2018 IECC Section 401.2 Application.
- 2.0 ASHRAE 90.1-2016 Compliance Requirements: Fan systems shall be provided in accordance with the requirements of Section 6.5.3 of ASHRAE 90.1-2016.
- 3.0 It is preferred that all fans shall be installed to permit servicing of the fan bearings, motor and drive package without the use of a ladder.
- 4.0 Units which are not floor mounted and are installed 6'-0" above the floor or higher must be provided with stable catwalks constructed of structural grade steel and steel grating. Access ladders shall be integral with the catwalks.
- 5.0 Centrifugal fans may be of the forward curved, backward inclined or airfoil types. The Engineer shall select the most efficient type for the operating pressure range of the system. Tubular in-line centrifugal or mixed flow fans may be considered for return air applications.
- 6.0 Fans serving variable air volume systems shall be controlled using variable frequency drives (Refer to Section 220500 for VFD motor requirements and 262900 for variable frequency drive requirements). Inlet vanes, discharge dampers, etc. are not recommended. For large manifolded systems, analyze fan operation and staging to verify that the required exhaust discharge velocity is maintained under all operating conditions.
- 7.0 Axial fans used in return air variable flow applications shall be controlled using variable frequency drives (Refer to Section 220500 for VFD motor requirements and Section 262900 for variable frequency drive requirements). Inlet vanes, discharge dampers, etc. are not recommended. Vaneaxial fans shall be of the direct drive adjustable pitch type.
- 8.0 Units shall be provided with safety control components such as firestats, smoke detectors and or smoke dampers which shall be provided per code.
- 9.0 All fans shall be AMCA certified. Provide fans rated for the particular class of operation based upon outlet velocity and static pressure in accordance with AMCA standards.
- 10.0 Fans with smaller wheel diameters operating at higher speeds, with higher power consumption and higher sound power ratings over the initial selections are unacceptable.
- 11.0 Motor sizes shall be selected to be non-overloading over the entire system performance range of the fan wheel size selected.
- 12.0 The use of ECM (Electronically Commutated Motor) is prohibited and shall only be used upon the approval of the University's Engineering Department.
- 13.0 Design fan speed shall be selected so as not to exceed 95% of the fan's listed maximum speed.
- 14.0 System performance requirements shall intersect the rising portion of the selected fan pressure curve on the negative slope to ensure fans are selected in a stable region.

- 15.0 Fans installed in exhaust systems handling corrosive vapors shall be coated or constructed of materials compatible with the intended environment and specific application. Fans shall have all motors, drives and bearings located out of the air stream. All fans for laboratory fume hood service must be reviewed with the University Engineering Department and the Office of Environmental Health and Radiation Safety (OEHRs). OEHRs shall review all manifolded laboratory exhaust systems.
- 16.0 Units shall be provided with hinged access/inspection doors located in the fan housing. Doors shall be secured on three (3) sides
- 17.0 All units shall be provided with belt guards and shaft guards, however direct drive fans are preferred to reduce maintenance costs. Belt guards to be two (2) piece design for ease of belt replacement and provided with holes to measure fan speed.
- 18.0 Units installed outdoors shall be provided with weather resistant construction.
- 19.0 Shafts and bearings shall be designed for an average life of L-10 200,000 Hrs. per ABMA L90.
- 20.0 Provide exterior units with scroll drains. Drains on units serving corrosive or toxic systems shall be installed with a valve.
- 21.0 Units serving flammable vapor systems or other potentially hazardous systems shall be of spark resistant construction. Type [A, B, C] shall be determined based upon nature of exhaust.
- 22.0 Units serving corrosive, toxic or other potentially hazardous systems shall be installed with reduced area discharge nozzles which create an effective stack height which exceeds the distance to the upper edge of the buildings near wake, above surrounding screens, parapet walls, etc. Discharge ductwork must be self-supporting or structurally supported. Guide wires are prohibited. For each project, review stack height, location and velocity with respect to adjacent building wind wake numerical or wind tunnel analysis. Discharge velocities shall conform to ANSI/AIHA Standard Z9.5.
- 23.0 The Engineer will review the noise and vibration levels of the units and provide isolation equipment as required to meet acceptable levels. Sound attenuators shall be provided where fan noise will be transmitted to interior spaces or exterior areas in excess of the levels permitted in Section 230000 for interior spaces. On a project by project basis, exterior installations of fans shall be evaluated against local site noise level goals and criteria. Refer to Part I, General Section XI.
- 24.0 Specify that all fans must be properly identified, including the type of exhaust being handled. Labels shall be of a permanent, metallic nature. Fans serving fume hoods must be identified by the room in which the fume hood is located. Each fan shall be labeled with the following:
- A. Fan Number issued by the Facilities Services.
  - B. System and area served (or fume hood and room number).
  - C. Location and circuit No. of electrical supply (Elec. Rm. A, MCC circuit No. 20).
- 25.0 Each unit shall be provided with a disconnect switch and general service electrical receptacle rated for 120 V, 15 AMPS.