ASHRAE STANDARD

Laboratory Methods of Testing Fans Used to Exhaust Smoke in Smoke Management Systems

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When addenda, interpretations, or errata to this standard have been approved, they can be downloaded free of charge from the ASHRAE Web site at http://www.ashrae.org.

Approved American National Standard

ANSI

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Laboratory Methods of Testing Fans
Used to Exhaust Smoke in Smoke Management Systems

NOTE

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1. PURPOSE

This standard establishes uniform methods of laboratory testing and test documentation for fans used to exhaust smoke in smoke management systems.

2. SCOPE

2.1 This standard covers fans that are to be permanently installed in smoke management systems to exhaust smoke, including fan components and accessories when supplied, mounted, or intended to be mounted to the fan.

2.2 This standard establishes test procedures for the following areas:

(a) Fan tests
  (1) Aerodynamic performance
  (2) Operation at specified elevated temperature
  (3) Reversal

(b) Appurtenance tests: Dampers

2.3 This standard does not cover the following types of fans:

(a) Portable fans
(b) Mechanical draft fans
(c) Circulating fans
(d) Attic fans
(e) Non-electrically driven fans

3. DEFINITIONS

ambient temperature: 10-40°C (50-104°F)

design temperature: the temperature at which the critical clearance(s) of the fan are identical to the critical clearance(s) of the fan at specified elevated temperature.

fan**:** a device that uses a power-driven rotating impeller to move air. A fan has at least one inlet opening. The opening(s) may or may not have an element or elements for connection to ductwork. For the purpose of this standard, *fan* shall be deemed to refer to the complete fan assembly as it is intended to be provided for smoke management.

smoke management system: An engineered system that includes all methods that can be used singly or in combination to modify smoke movement.[1]

specified elevated temperature: the temperature at which the operation test shall be conducted.

stabilized**:** A temperature is considered to be stabilized when three successive readings, taken at intervals of 10% of the previously elapsed duration of the test, but not less than five-minute intervals, vary no more than 3°C (5°F).

standard conditions: 20°C, 1.2 kg/m^3 (68°F, 0.075 lb$_m$/ft^3).

4. REQUIREMENTS

4.1 General. The fan and its accessories (when supplied, mounted, or intended to be mounted to the fan) shall be tested as an assembly. Test setups, apparatus, instruments, data to be recorded, and data to be reported shall be in accordance with referenced standards except as indicated in this standard.

4.2 Test Parameters Required (Relevant Test). Prior to the test, the following items shall be specified by a party or document other than this standard. For parameters (g) and (h), see 5.4.3.2.

(a) Elevated temperature (aerodynamic performance and operation at specified elevated temperature tests)
(b) Number of restarts and running time between restarts if more than one restart is required. (operation at specified elevated temperature test)
(c) Duration (operation at specified elevated temperature test)
(d) Number of reversals (reversal test)
(e) Time delay (reversal test)
(f) Run time (reversal test)
(g) Wind load (damper test)
(h) Snow load (damper test)

5. TESTS

5.1 Test of Aerodynamic Performance

5.1.1 General

5.1.1.1 The performance of a fan is affected by temperature in two ways: First, since a fan is basically a constant volume device, the decrease in density accompanying an increase in the temperature of the gas passing through the fan will cause a decrease in the mass flow. This first effect is adequately accounted for by making a density correction as defined in *ANSI/ASHRAE 51:ANSI/AMCA 210,*[2] ignoring the density correction limitations (see Annex A). Second, the fan components will change size as the temperature of these components increases, and, if this change in size is not the same for all components, the resulting changes in clearances may cause a difference in fan performance. The change in performance is due to a change in some critical clearance when expressed as a percentage of some nominal dimension rather than a change in the nominal dimension itself. This effect, if present, is not taken into account when the density correction is made and requires either an aerodynamic performance test at the specified elevated temperature or an aerodynamic performance test of a fan with the geometry set to the configuration expected at the specified elevated temperature.

5.1.1.2 The calculation of the geometry expected at the specified elevated temperature can be determined using the assumption that each material has a constant coefficient of linear expansion. The prediction of size change of any component requires a knowledge of the temperature of that component and the coefficient of linear expansion of the material from which the component is constructed. Geometric changes that will affect performance will occur when the critical components do not expand at identical rates due to differences in rates of expansion of dissimilar materials or differences in operating temperature of the components or both. It is assumed that the temperature of all components has stabilized.