Will Fire Resistive Gypsum Shafts continue to be the best available Option?

Recently, there has been a significant increase in the number of manufacturers providing tested and listed fire resistive duct enclosures for grease and ventilation duct systems as alternatives to fire rated shaft wall construction. For the first time in the International Code Council history, the 2006 International Mechanical Code now specifically defines the required test methods for fire resistive duct enclosures for grease duct systems.

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The change requires field applied grease duct enclosure assemblies to comply with ASTM E3298, while prefabricated, factory built systems should comply with UL 2221. Although these code changes only apply to fire resistive duct enclosures for grease duct systems, it is significant because for the first time the code clearly recognizes an alternative to the fire resistive shaft construction enclosure assembly, which is tested in accordance with ASTM E 119/ UL 263. The article examines the existing industry of fire resistive duct enclosure systems and future impacts on fire rated gypsum shaft requirements in codes.

2006 International Mechanical Code 9.505.3.10 Grease duct enclosure. A grease duct enclosure should be enclosed in accordance with the International Building Code requirements for shaft construction. Clearances from the duct to the interior surface of enclosures of noncombustible construction or gypsum wall board attached to noncombustible structure shall be not less than 6 inches (152 mm).

I. The shaft enclosure provisions of this section shall not be required when the surface of the duct is continuously covered on all sides with a classified and labeled material, system, method of construction or product specifically evaluated for such purpose, in accordance with ASTM E 2536.

II. The shaft enclosure provisions of this section shall not be required where a prefabricated grease duct enclosure assembly is protected on all sides from the point at the...
assemblies with an exposure of 100 square feet of wall to the fire, with a minimum wall dimension of 9 feet.

The acceptance conditions under ASTM E119 consists of the wall assembly withstand the fire-endurance and hose stream portions of the test, without any openings occurring in the wall system and with minimum transmission of heat through the assembly.

**Shaft Alternatives**

Shaft alternatives (fire resistant grease and ventilation duct enclosure systems) were created as a space and labor savings alternative to the typical fire resistant gypsum shaft construction. Costs aside, the use of a field-applied or prefabricated fire resistive duct enclosure system is far more appealing to mechanical engineers, contractors, and architects since it provides design flexibility and allows complex ductwork configurations.

Fire resisting duct enclosures have been fire tested to standards that evaluate the system in the configuration that would exist in the field (enclose a full-scale duct system tested in horizontal and vertical orientations, under operational temperatures and fire conditions). Shaft enclosures are tested as a wall per ASTM E119, a configuration that does not match the orientation of the system when installed as a four sided enclosure for a duct operating at elevated temperatures for extended periods of time.

**Grease Ducts**

The fire resistance performance of a grease duct assembly is investigated in accordance with ASTM E2216 or UL 2221. The International Code Council Evaluation Service first developed an Acceptance Criteria for Grease Duct Enclosure Assemblies in 1994, AC101. The AC101 acceptance criterion was developed to provide an evaluation method for fire resistive grease duct enclosure systems since no such criteria existed within the model codes.

ASTM E2236 was developed to mimic the AC101 acceptance criterion but contained mandated language that could be referenced in the code. ASTM E2236 is used to evaluate the performance of grease duct enclosure system, field applied or prefabricated. UL 2221 was developed concurrently with ASTM E2236, but specifically addresses methods for evaluation of prefabricated duct enclosure systems.

The majority of design findings and labeled materials in existence today are based on the provisions of the ASTM E2236 standard. This test method evaluates the enclosure materials and the grease duct enclosure systems using the following test methods: noncombustibility, fire resistance, durability, internal fire, and fire engulfment with a through-ventilation fire stop.

The internal fire portion of ASTM E2236 consists of the temperature inside the duct being raised to 500°F (260°C) and maintained for a minimum of four (4) hours. The temperature is then raised to 2000°F (1093°C) within 15 minutes and then maintained for an additional 30 minutes.

The fire engulfment test involves simulating an exposure of the enclosure system to fire occurring from an outside source. A 10 foot long and 4 foot high V-shaped duct assembly is tested in a horizontal furnace under the conditions required in ASTM E119.
Advantages

The primary advantage of field applied or a prefabricated fire resistive duct enclosure system is the space savings. When a gypsum wallboard shaft is utilized, the inside layer of the wall board shaft is required to be no less than six (6) inches from the duct surface. One of the possible reasons for such a clearance requirement is that the fire resistivity of gypsum relies on its ability to release water as it is heated. However, when exposed to constant high temperatures such as when a grease duct is continuously used during business operations, it can slowly dry out over time and lose its endothermic fire resistivity characteristics. Alternative products have been tested with poor clearance to combustibles so that the unexpanded enclosure surface can be in contact with combustible construction material. The space savings aspect of fire resistive grease duct enclosure systems and ease of installation for tight spaces has given it the needed momentum to make its way into the IMC as an accepted alternative.

HVAC Ducts

In addition to the new grease duct shaft alternative provisions in the IMC 2006 Eds, the ICC ES introduced a new Acceptance Criteria in 2005 for Metal HVAC Duct Enclosure Assemblies, the AC 179. AC 179 includes testing the duct assembly as a Wall in accordance with ASTM E118 for the desired hourly rating, identical to how gypsum shaft wall assemblies are tested. To date, no manufacturer has a tested and listed system in accordance with AC 179. Discussions within the fire resistive duct enclosure community are on going to determine if AC 179 is representative of actual field conditions. It is anticipated that minor modifications will be made before manufacturers of enclosure systems begin listing and testing per AC 179.

The introduction of AC 179 in 2005 is analogous to the introduction of the AC101 for Grease Ducts in 1995. A decade later, fire resistive grease duct enclosure systems are cited in the IMC as acceptable alternatives, the same as true for ventilation ducts, in five (5) to ten (10) years.

The AC 179 also consists of testing the field applied or prefabricated enclosure system in accordance with ISO 6944 1985, "Fire Resistance Tests - Ventilation Ducts." Two duct configurations can be tested, Duct A or Duct B. Duct A consists of a closed duct system with a vacuum drawn from within the duct while it undergoes the furnace engulfment test. Duct B is an open duct system tested to the same fire curve as Duct A. The ISO 6944 is tested to the ISO 834 time temperature fire curve, which is similar to the ASTM E119 fire curve.

Similar to how ASTM created ASME 3221B based on the ICC ES AC101, ASTM is working on a draft to standardize fire test methods for fire enclosures of ventilation ducts. The ventilation duct test criteria will be more complicated and will have options for testing such as open and closed systems because ventilation ducts are used in several ways. Such as typical supply air distribution in buildings, smoke control exhaust, and stair and elevator shaft pressurization.

ISO 6944 Ventilation Duct Test

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