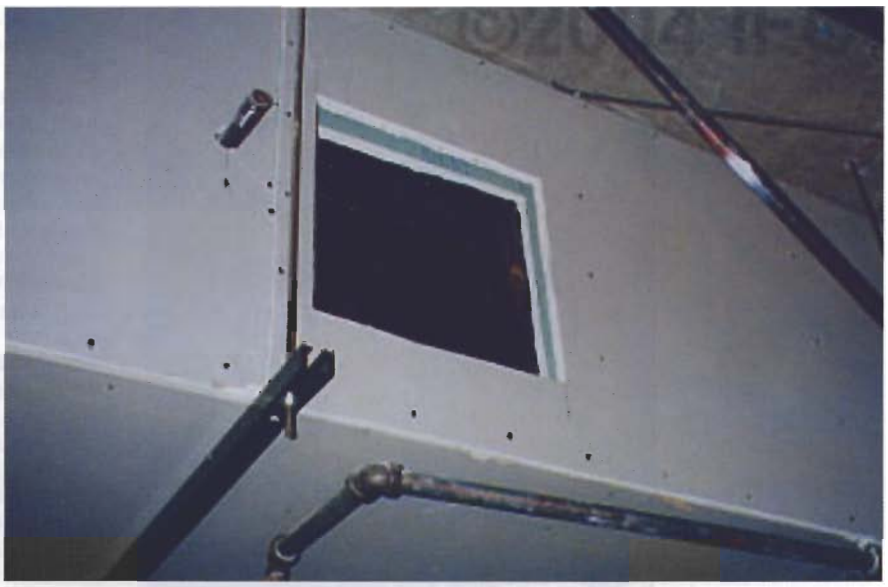

Fire rated Shaft Enclosure

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 E2336, 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

a. **506.3.10 Grease duct enclosure.** A grease duct Ducts should be enclosed in accordance with the *International Building Code* requirements for shaft construction. Clearance from the duct to the interior surface of enclosures of noncombustible construction or **gypsum wall board** attached to noncombustible structures shall be not less than 6 inches (152 mm).

i. 1. The shaft enclosure provisions of this section shall not be required where 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 2336.

ii. 2. 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

ASTM 2336 Internal Fire Test

which the duct penetrates a ceiling, wall or floor to the outlet terminal with a classified and labeled prefabricated system specifically evaluated for such purposes in accordance with UL 2221.

Today's code requirements for shafts

The 2006 International Building Code Section 707 requires a shaft wall for any opening within a floor slab assembly connecting more than one floor. There are a number of exceptions which omit shaft construction such as firestopping pipe penetrations per ASTM E 814. In general, penetrations by HVAC ducts of floor assemblies are to be enclosed in shafts that are constructed in accordance with Section 707.

The fire-resistance rating of the fire barrier gypsum wallboard assemblies separating building areas from a shaft are tested in accordance with ANSI/UL 263 (ASTM E119 and NFPA 251), "Fire Tests of Building Construction and Materials." The ratings are expressed in hours. Wall systems evaluated under ASTM E119 are typically full-scale 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 withstanding 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 resistive grease and ventilation duct enclosure systems) were created as a space and labor savings alternative to the typical fire resistive 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 resistive 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 resistive performance of a grease duct assembly is investigated in accordance with ASTM E2336 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 E2336 was developed to mirror the AC101 acceptance criteria but contained mandatory language that could be referenced in the code. ASTM E2236 is used to evaluate any type of grease duct enclosure system, field applied or prefabricated. UL 2221 was developed concurrently with ASTM E2336, but specifically addresses methods for evaluation prefabricated duct enclosure systems.

The majority of design listings and labeled materials in existence today are based on the provisions of the ASTM E2336 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-penetration fire stop.

The internal fire portion of ASTM E2336 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 L-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 resitivity of gypsum relies on it's 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 resitivity characteristics. Alternative products have been tested with zero clearance to combustibles so that the unexposed 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 Code, the ICC ES introduced a new Acceptance Criteria in 2005 for Metallic HVAC Duct Enclosure Assemblies, the AC179.

AC 179 includes testing the duct assembly as a wall in accordance with ASTM E119 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, will the same be 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 ASTM E2236 based on the ICC ES AC101, ASTM is working on a draft to standardize a fire test method 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.

Prefabricated fire resistive duct enclosure system

Advantages

Currently ventilation duct standards (ISO 6944 and AC179) are designed only to evaluate fire performance of ducts with protection systems. Neither the current testing, nor the draft ASTM method currently includes provisions to evaluate the impact of damper removal. In addition fire resistive duct enclosure manufacturers and the International Firestopping Council (IFC) are not lobbying to develop test standards or products specifically designed to replace code required fire dampers used in ventilation duct systems.

Similar to the motivation for fire resistive grease duct enclosure systems, space savings is the key theme. However, it would be a very marketable feature if the use of fire dampers was unnecessary with a tested ventilation duct enclosure system, from a cost and maintenance perspective.

Summary

In years past, opportunities for shaft alternatives were limited due to the familiarity and widespread acceptance of ASTM E119 tested gypsum wallboard shafts. Over the past decade, test standards for evaluating grease and ventilation duct enclosure systems have been developed and are being integrated into national and local mechanical codes. Fire testing results have validated system performance as a shaft alternative, and extensive installation experience has allowed manufacturers to clearly define the space and labor savings which are a benefit to designers and installers. The market has embraced fire resistive duct enclosures as a viable alternative to shafts and opportunities for these systems will continue to grow as test standards and codes continue to be further developed. IFP

ISO 6944 Ventilation Duct Test