Fire Rated Ducting

Shaft Alternative for Air Distribution Systems (ADS)

Fire rated duct enclosures are increasingly being accepted as a shaft alternative for air distribution systems (ADS) by design professionals and code officials.

Shaft alternatives, such as ducts protected with flexible fire rated duct wrap, provide solutions for better building space utilization and physical access to air control equipment. Listed and Labeled systems verify performance when tested under duct application conditions and provide documentation necessary for code compliance. The benefits of these systems can help resolve current project issues and offer potential future building design options.

Fire rated duct requirements, challenges and benefits

Innovative design, retrofit occupancy changes and the push to achieve greater efficiencies in all aspects of building construction present challenges for designers, installers and code officials. These challenges certainly include balancing air distribution system functionality with fire protection requirements within the shared space of structural building elements and other building service items. Requirements for fire protecting duct systems are clearly defined in the International Building Code (IBC) utilized for building construction in the United States. This code dictates duct systems that pass through fire rated horizontal assemblies shall be...
Enclosures

located in shafts; transfer openings in shafts are to be protected with fire or combination fire/smoke dampers; and specialized ventilation systems such as ducts serving smokeproof enclosures and exit enclosures shall be enclosed in construction as required for shafts or ductwork enclosed by 2 Hour fire barriers. Despite these prescriptive requirements, unique job site conditions arise where “alternatives” to shafts (often referred to as fire rated duct enclosures) offer potential solutions and therefore are given consideration.

These conditions can include but are not limited to:
- Insufficient space to construct a shaft enclosure
- Inadequate access to fire dampers for maintenance, requiring the shaft enclosure be “extended” to the new damper location
- Fire rated enclosure of ducts that pass through exit enclosures and exit passageways
- Penetrations of shafts where steel subducts are installed but lack continuous vertical air flow
- Penetrations of shafts by kitchen, clothes dryer, bathroom and toilet room exhaust openings, where steel subducts are installed but the exhaust fan lacks continuous power in Group B (Business) and Group R (Residential) Occupancies.

For these situations and others, there are numerous benefits to using fire rated duct enclosures including flexible duct wrap systems. The most common include:
- Uses less space than shaft construction, thin installed profile
- Potential for more effective space utilization
- Contours to fit complex configurations
- Easy material handling
- Lower installed cost
- Listed and labeled systems

Existing and potential fire rated duct applications that could benefit from shaft alternatives include:
- Smoke control, including stairwell & vestibule pressurization ducts
- Exit enclosures and passageways
- Bathroom and toilet exhaust
- Commercial dryer exhaust
- Trash & linen chutes
- Hazardous ducts

The building code does not define shaft alternative requirements for an air distribution system (except for commercial kitchen grease ducts). Therefore, Section 104.11 of the IBC can be utilized, which permits “An alternative materials, design or method of construction to be approved, where the building official finds the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method, or work offered, is for the purpose intended, is at least the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability, and safety.” This option is further defined in Chapter 7 on Fire Resistance Rated Construction, Section 703.3 Alternate methods for determining Fire Resistance. Approvals for Alternate Materials and Methods are typically granted for project specific requests. Applications should include supporting documentation, preferably with Listed and Labeled systems tested at an IAS accredited testing lab & inspection agency, which are recognized by ICC. Accreditation Listings can be found at www.iasonline.org or 562-699-0541. Intertek Testing Services and Underwriters Laboratories are examples of accredited companies.

Shaft alternative: performance criteria

One guideline for defining shaft alternative performance criteria is the International Mechanical Code (IMC), Section 506.3.10 Grease Duct Enclosures. For this specific air distribution system application, the code states, “Duct enclosures shall have a fire resistance rating not less than that of the floor assembly penetrated, but need not exceed two hours.” Enclosure protection can be provided via IBC requirements for shaft construction, a field-applied grease duct enclosure or a factory-built grease duct assembly. Section 506.3.10.2 Field Applied Grease Duct Enclosure,
defines the criteria that must be met for it to be used as an alternate to a shaft. This includes:

1. Listed and labeled material, system, product or method of construction specifically evaluated for such purpose (as a duct enclosure configuration).
2. Fire tested per ASTM E2336 (under full scale application conditions, including ASTM E119 engulfment fire test).
3. Duct continuously covered on all sides from the origin to the outlet terminal.
4. Duct penetrations sealed with firestop system tested per ASTM E814 or UL 1479.
5. Firestop system shall have an F and T rating equal to the fire resistance rating of the assembly being penetrated.

In this example, the fire rated duct enclosure demonstrates equivalency to a shaft by limiting fire penetration and temperature rise to the next compartment (per ASTM E119 criteria). Both criteria must be met and results are reported as F Ratings and T Ratings. Temperature rise limitations are a mandatory component of ASTM E119, used to define a shaft. Therefore, T Ratings that are equivalent to the F Ratings are mandatory for firestops installed on grease duct enclosure systems used as shaft "alternatives". See Table 1.

**Extension of performance criteria to ADS ducts**

It is logical that the shaft alternative performance criteria for grease duct enclosures defined in the IMC can be used as a model for other type air distribution system (ADS) duct enclosures. Since the IBC requirements for fire protection of ducts is based on enclosure in shafts, then a shaft alternative for ADS would have the same performance objectives and components as grease ducts, using an engulfment fire exposure test conditions appropriate for ADS duct application. Using this philosophy, the ADS fire rated duct enclosure system must provide equal fire and temperature ratings to demonstrate equivalent performance to a shaft.

ISO 6944-1985 (BS 476 : Part 24) "Method for Determination of the Fire Resistance of Ventilation Ducts" is utilized extensively in Europe and other

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Duct Enclosure (ASTM E119) Fire Resistance Rating</th>
<th>Penetration Opening (ASTM E814)</th>
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</thead>
<tbody>
<tr>
<td>Fire Penetration</td>
<td>No collapse of duct support</td>
<td>F Rating – no openings through firestop</td>
</tr>
<tr>
<td></td>
<td>No passage of flame throughout</td>
<td></td>
</tr>
<tr>
<td>Temperature Rise</td>
<td>Temperature rise limit on</td>
<td>T Rating – temperature rise limit on unexposed side of firestop</td>
</tr>
</tbody>
</table>

Table 1. Grease Duct Enclosure Shaft Alternative Performance Criteria
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Through-penetration firestop system with thermocouples measuring unexposed surface temperature of duct enclosure and sealant to determine compliance with requirement for equal F and T ratings.

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parts of the world to evaluate the fire resistance rating of ventilation air ducts and duct enclosure systems. This standard evaluates full scale duct systems under application conditions, which is representative of the configuration they will be installed in the field. Performance per ISO 6944 is reported with the following Ratings:

- Stability Rating – no duct collapse (of duct support system)
- Integrity Rating – no passage of flames (through duct or opening)
- Insulation Rating – temperature rise limit (through duct or opening to unexposed side)

Testing per this standard is conducted by North American laboratories (including those with IAS Accreditations and recognized by ICC). Listed and Labeled systems are available on line in each lab's Listing Directory. Design listings reflect the individual ratings achieved for each criteria. However the equivalent fire resistance rating for the system is the lowest rating achieved of the three. Manufacturers of fire rated duct systems under consideration for approval should produce evidence of an Insulation Rating that is at least equal to the fire resistance rating of the assembly penetrated. Approvers should be cautious, as not all systems have achieved an insulation rating that matches the assembly, which demonstrates equivalency to a shaft.

Acceptance by local jurisdictions

Some jurisdictions are developing acceptance criteria for fire rated duct enclosures for ventilation air ducts or ADS. This permits broader approval of the systems and elimination of the need to apply for approval of Alternate Methods and Materials on an individual project basis. Support documentation typically includes Fire Resistant Duct Design Listings provided by IAS accredited labs as evidence of successful fire testing.

One example of a major metropolitan area and jurisdiction that has developed acceptance criteria for the ADS application is the New York City Buildings Department. Their Office of Technical Certification and Research (OTCR) has defined the acceptance criteria for Fire Rated Flexible Duct Wrap Insulation as an Alternate Material in the 2008 NYC Construction Codes under Building Bulletin OTCR 2009-028. Fire rated duct assemblies (duct plus enclosure materials) shall be tested per ISO 6944, ASTM E814 and ASTM E84. Minimum F and T Ratings for the assembly are mandated and defined in the bulletin. Similar criteria are being considered for adoption by many other cities, indicating a growing trend of acceptance for ADS duct shaft alternatives.

An ASTM Test Standard for fire rated ventilation ducts is under development. Once published, this standard can then be considered for inclusion in appropriate sections of Building Codes that cover duct fire protection requirements. Testing and Listing of duct enclosure systems per this new ASTM standard can then be conducted at national testing laboratories providing additional evidence of compliance with shaft alternative criteria.

Evolution from project solver to design option

The use of fire rated duct enclosures as shaft alternatives have provided designers, installers and code officials with solutions to unique project conditions. There is no doubt the benefits associated with flexible duct wrap systems are evolving this technology from project solver to design option, creating the potential to value engineer solutions as the building is being designed. The culmination of industry activities already underway aim to provide AHJ's with a code defined criteria for shaft alternatives beyond grease duct systems. In the meantime, existing Listed and Labeled fire resistive duct enclosure systems are available as supporting evidence for local project submittals and acceptance criteria.

Footnotes

1. International Code Congress, 2006 International Building Code (IBC), Section 104.11.
2. International Code Congress, 2009 International Mechanical Code (IMC), Sections 506.3.10 and 506.3.10.2.

References


FyreWrap® Elite 1.5 Duct Insulation provides fire protection you can count on, when it counts the most.

FyreWrap® Elite™ 1.5 Duct Insulation is ideal for the insulation of grease and HVAC duct systems in densely populated areas such as hotels, schools, restaurants, high rise condos, medical facilities, research labs, and sports arenas and stadiums. This lightweight, flexible material also saves valuable building space and minimizes labor and installation time.

FyreWrap Elite 1.5 Duct Insulation offers:

- 2 hour fire-rated duct protection
- Space-saving shaft alternative for grease and HVAC ducts
- Thin, lightweight flexible blanket for faster, easier installation
- Zero clearance to combustibles
- Complies with NFPA 96, ICC and IAMPO Codes

- Solutions for building design and complex job configurations
- Offers both fire and insulation performance; made in USA

A FyreWrap product specification in several formats is available at www.arcat.com; search using keywords Unifrax, FyreWrap or www.unifrax.com. For additional information on FyreWrap Elite 1.5 or other products, certifications, code compliance, installation instructions or drawings, contact Unifrax Corporate headquarters USA at 716-278-3800.

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