

IFP

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A Wrap for a World of Passive Fire Protection Applications

Wherever high heat or potential fire is a problem, UNIFRAX FyreWrap® Fire Protection Products offer solutions to a variety of passive fire protection applications when lightweight, thin materials are needed to prevent flame penetration and achieve a significant temperature reduction.

FyreWrap products are used around the world to perform critical passive fire protection functions throughout the commercial building, transportation, and manufacturing industries. At Unifrax, we provide innovative passive fire protection solutions that make everyday life safer. We offer our FyreWrap product line as a premiere passive fire protection brand, providing proven life safety systems that meet international fire standards and local code requirements.

Some common FyreWrap fire protection applications include: fire-rated enclosures for kitchen exhaust and HVAC ductwork and marine bulkhead and deck insulation, through penetration fire-stops, construction joints, fire doors and seals, and electrical circuit protection systems. Applications all of which are tested, listed, and under follow-up service with leading internationally recognized certification bodies.



Select Applications

The fire protection of ventilation and kitchen exhaust ductwork in commercial buildings is an important life and property safety measure. In the event of fire, unprotected ductwork has the potential to quickly spread fire to other rooms or floors. Proper passive fire protection most importantly saves lives, but may also prevent severe and extensive property damage. Over the past 20 years, FyreWrap Elite 1.5 has gained international recognition as a proven means of fire protection for duct applications that include, but are not limited to: kitchen exhaust, smoke control, stairwell and vestibule pressurisation, supply/return ducts, commercial dryer exhaust, as well as refuse and linen chutes.

Thousands of architects, engineers, contractors, and building owners have experienced the advantages, providing design flexibility and space and labour savings over existing materials. FyreWrap duct wrap products are sold in every major international market and have the most extensive certifications across the board to ASTM, ISO, EN, AS, and UL standards.

In the marine industry, vessels and offshore platforms require passive fire protection in critical areas for life safety and equipment protection. Bulkheads and decks are commonly insulated with fire resistant, high temperature insulation that complies with IMO Regulations. Unifrax offers specialised version of a low bio-persistence fibre blanket called FyreWrap Marine Blanket, specifically manufactured to meet these requirements. This material offers superb insulation value in a flexible lightweight non-combustible form. This offers builders and owners reduced structure weight, which may yield increased vessel speed, fuel savings, and available payloads.

Unifrax offers marine systems that:

- Are ABS, USCG, and Lloyds Certified for steel and aluminium structures.
- Comply with SOLAS safety objectives.

- Meet IMO FTP code fire test requirements, Res. A.754(18).
- Comply with Fire Resisting Division for High Speed Craft (HSC); Res. MSC.45 (65.)

Many industrial processes require quick, controlled shut down of critical equipment in an emergency to eliminate or minimise the threat of fire and explosion causing potential loss of life, equipment, and business operations. FyreWrap cable insulation provides an external insulation wrap around cables trays and conduits to provide a fire rated enclosure, permitting continued operation for a specified period of time. FyreWrap cable systems are FM Global approved and comply with many industry specifications on fireproofing for petroleum and petrochemical processing plants.

About Unifrax

Unifrax is a global leader in high-performance specialty products used by many industries in a diverse group of applications. Unifrax employs over 2,500 people worldwide with 27 manufacturing facilities and various regional and sales locations in the United States, Europe, Asia, South Africa and Latin America.

Our purpose, mission and values are based on our commitment to produce high quality specialty products that help our worldwide customers save energy, reduce pollution, and improve fire safety. Our commitment to customer satisfaction continues the tradition of supplying quality products that meet our customers' application, while maintaining the strong spirit of innovation that has always been a hallmark of our business. This focus on providing innovative products and services continues to position us as a leader in our industry. Outstanding customer service and knowledgeable technical support continue to be the cornerstones of our success.

For more information, go to www.unifrax.com

FyreWrap® DPS Insulation just opened the door *to improved dryer duct fire protection.*



Recent NFPA statistics indicate significant injuries, loss of life and property damage due to clothes dryer fires in residential buildings. At the same time, code requirements for dryer exhaust ductwork in multi-family residences have been difficult to achieve in real-world conditions – until now.

Introducing new FyreWrap® DPS Insulation for dryer ducts and plenums.

FyreWrap® DPS Insulation is an innovative duct wrap that provides a safe and cost-effective means to achieve a 1-hour fire resistance-rated enclosure for routing dryer ductwork through rated wood construction. It utilizes a lightweight, high temperature, low bio persistence fiber blanket specifically designed, UL tested and classified for this

critical application. It also provides code compliant fire protection for combustible items such as plastic pipes in the plenum area. FyreWrap DPS Insulation features a ½", single layer design that is flexible and easy to cut, fabricate and wrap to fit tight spaces, providing time- and cost-savings on many projects.



More information on FyreWrap DPS and our complete line of FyreWrap products is available at www.arcat.com and www.unifrax.com or by calling 716-768-6500.

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Fire Wrap Systems as Alternative to Fire Rated Shaft Construction

Life safety ducts such as those supplying fresh pressurization air to an exit stairwell or those designed to extract smoke from a fire area in a building are just a few amongst the many air distribution system (ADS) duct types required by code to be protected from fire in a commercial building. As building codes and fire test standards have evolved over the years, the presence and acceptance of flexible fire rated duct wrap systems as alternative to gypsum shaft enclosures to provide the required hourly duration of protection has immensely increased.



Mike Kerrison

Mike Kerrison is the Fire Protection Product Manager at Unifrax I LLC with over 12 years' experience in various engineering and marketing positions supporting the passive Fire Protection Business. In addition to running full scale fire testing programs, during his time at Unifrax Mike has conducted numerous educational seminars for architectural firms, engineering firms, state and local code authorities, as well as insulation and mechanical contracting companies.

Many situations present themselves in a commercial building that create an advantage for using flexible duct wrap systems as an alternative to gypsum shaft assemblies to provide the necessary fire resistance rating. A few of these situations include:

- Lack of the necessary space required to build a properly constructed code compliant gypsum shaft
- Complex duct configurations
- Other construction items such as other ducts, pipes, equipment, and the support structures for such, creating additional space constraints

▼ Duct with complex geometry, close to other service items.

- "Cross-over" floor ducts that come out of one fire rated gypsum shaft, run horizontal to the other side of the building, and re-enter another gypsum shaft
- Ducts that pass through fire rated stairwells and exit ways

What is a flexible fire wrap system?

They are referred to as "systems", since the flexible wrap products are fire tested in conjunction with the duct to be protected. Thus they are not fire rated wrap "products", rather the product and duct tested together become the fire resistance-rated duct "system". In contrast, a gypsum shaft assembly is not actually tested as four walls enclosing the duct, but rather as an individual shaftwall, which is clearly not a duct "system".



Image courtesy of Unifrax



▲ Duct passing through exit stairwell.

Flexible fire wrap products typically consist of high temperature (operating temperatures upwards of 2000°F), low bio persistence fiber blankets completely encapsulated in scrim reinforced foil. These fiber blankets typically do not utilize organic binders, rather they are manufactured with a needling process intertwining the fibers creating a completely noncombustible product form. The scrim reinforced foil encapsulation adds handing strength for installation,

▼ Duct with insufficient space to construct proper code compliant shaft.

helps the product resist moisture, as well as providing a location to print the product identification and certification information for use by Code Officials to properly identify the product installed.

Duct types

As previously mentioned, there are many duct types that are required by the building codes to be protected from fire. Among the list of those duct types include:

- Stairwell and vestibule pressurization
- Smoke control
- Supply/return
- Commercial dryer exhaust
- Hazardous and laboratory exhaust
- Bathroom and toilet exhaust



Advantages of using flexible wrap systems

- Thin profile uses less space than shaft construction allowing more habitable square footage in a given building space and solves space constraint issues
- Easily contours to accommodate complex duct configurations
- Lightweight material (typically 6 lbs/ft³ density) allows for easy handling
- Installed cost lower than gypsum shaft construction
- Listed and Labeled systems fire tested as one complete system with the duct

Approval process

Since the International Building Code (IBC®) published by the International Code Council, enforced throughout the United States, does not define requirements for shaft alternatives for ADS ducts with the exception of commercial kitchen grease ducts (ASTM E2336 is used for grease ducts, listed in the International Mechanical Code – IMC®), section 104.11 of the IBC is utilized for alternate systems approval. Section 104.11 titled “Alternative materials, design and methods of construction and equipment” states: “An alternative material, design or method of construction shall be approved where the building official finds that 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, at least the equivalent of that prescribed in this code in quality, strength, effectiveness, fire resistance, durability and safety.” Further to this, section 703.3 of the IBC titled “Alternative methods for determining fire resistance” provides additional information for alternative methods for fire resistance rated assemblies as suggested by the title.

In general, approval for use is achieved by providing documentation for tested, Listed and Labeled systems. The term “Listed and Labeled” systems refers to systems that are tested at, and Listed and Labeled by an IAS (International Accreditation Service) accredited testing organization. With this, the manufacturer abides to a “Follow up Service” program in which the manufacturing facility is randomly visited by a laboratory representative to witness material production and verify the material is consistently being produced within the

Image courtesy of Unifex

specification of that fire tested. Intertek Testing Services and Underwriters Laboratories are both examples of IAS accredited Laboratories.

For years, fire resistance-rated duct systems utilizing flexible fire wrap products were approved on a case by case basis for projects, upon special request. As the industry, education, and awareness of said systems has evolved over the years, it has moved in the direction of accepted practice as opposed to case by case. These systems are being specified by Architects and Engineers alike as an alternative to gypsum shaft assemblies and widely accepted throughout North America by Code Officials.

Performance criteria

Section 703.3 of the IBC as previously referenced states “The application of any of the alternative methods listed in this section shall be based on the fire exposure and acceptance criteria specified in ASTM E119 or UL 263.” Due to the lack of a fire test standard that addresses ADS duct performance in a fire scenario (other than grease duct systems) utilizing ASTM E119 time-temperature fire exposure, ISO 6944-1985 Fire Resistance Tests – Ventilation Ducts (BS 476: Part 24) is the recognized standard used for testing flexible fire wrap ADS duct systems. This fire test standard utilizes the ISO 834 time-temperature fire exposure curve. In 1987, a study was conducted by The American Society for Testing and Materials (ASTM) and the National Research Council Canada (NRCC) comparing the ASTM E119 and ISO 834 time-temperature fire exposure conditions. The results were compiled in ASTM’s Journal of Testing and Evaluation in a publication titled “Comparison of Severity of Exposure in ASTM E119 and ISO 834 Fire Resistance Tests”. The results showed that for fire tests in duration upwards of 1.5 hours, the exposure differences between the two are negligible, thus providing technical justification for acceptance of ISO 6944-1985 tested systems.

ISO 6944-1985 uses three specific performance criteria for reporting the fire resistance rating of the duct system. The rating (tested in both vertical and horizontal orientations) is the duration in minutes when exposed to ISO 834 time-temperature fire exposure conditions until failure occurs per one or more of the following:

- Stability – When the duct collapses in such a manner it no longer fulfills its intended function
- Insulation – Temperature rise limit on the duct wrap surface outside the furnace exceeds pass/fail
- Integrity – Passage of flames or hot gases enough to create flaming on the unexposed side

In order to be considered as a shaft alternative per the above criteria, all three performance criteria must be achieved to equal or greater hourly duration than that of the required shaft enclosure. The IBC section 707 requires shafts that penetrate four stories or higher to be two hour fire resistance rated, with three stories or less being one hour.

In addition to that, systems are tested, Listed and Labeled per ASTM E814 – “Standard Test Method for Fire Tests of Penetration Firestop Systems”. Testing to this standard demonstrates that for locations where the fire resistive duct system passes through fire resistance rated walls and floors, it maintains the fire resistance rating of the wall or floor penetrated by selecting the system with equal hourly ratings of that being penetrated.

Two hourly ratings are established and reported:

- F Rating – No flaming on the unexposed surface
- T Rating – Temperature rise criteria on the surface of the penetrating item remains below pass/fail temperatures (325 °F over ambient)

▲ Duct above drop ceiling lacking space for proper shaft construction.



New fire test standard – ASTM E2816

Due to the code structure and requirements for ASTM E119 time-temperature fire exposure conditions within code Section 703.3 of the IBC, demand for development of a new standard to evaluate ADS duct systems (except grease ducts) per ASTM E119 criteria continued to increase. ASTM E2816 – “Standard Test Methods for Fire Resistive Metallic HVAC Duct Systems” was first published in 2009, the result of extensive industry input and a consensus based process. Over the following few years, the standard content was revised for clarity and “usability”.

This fire test standard utilizes ASTM E119 time-temperature fire exposure conditions to evaluate four separate full size duct configurations: horizontal-open, vertical-open, horizontal-closed, and vertical-closed, thus evaluating for fire “inside” and “outside” the duct scenarios. This standard also includes evaluation and reporting of the mechanical support systems for the duct as well as well as transition connections from vertical to horizontal duct configurations. In addition, this standard evaluates a number of attributes of the flexible fire wrap materials protecting the duct including the combustibility, flame spread and smoke generation, and durability properties. ASTM E814 testing of the through penetration firestop system as described above is also included within this standard.



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Grease duct systems paved the way

Section 506.3.11.2 of the International Mechanical Code (IMC) titled “Field-applied grease duct enclosure” states “Commercial kitchen grease ducts constructed in accordance with Section 506.3.1 shall be enclosed by field applied grease duct enclosure that is a listed and labeled material, system, product, or method of construction specifically evaluated for such purpose in accordance with ASTM E2336.” While flexible fire wrap systems have been used for grease ducts dating back to before the year 2000 and accepted as alternate systems, it wasn’t until the 2006 edition of the IMC when ASTM E2336 was written into the code. While initially listed as an exception to the shaft requirement it was later moved to its own section in 2009. Having the accepted fire test standard incorporated directly in the code eliminates the need for utilizing the Alternate Methods procedure described previously in this article. Prior to 2006 and the development of the ASTM test method, flexible fire wrap systems for grease ducts were accepted by documenting compliance with AC101 – “Acceptance Criteria for Grease Duct Enclosure Assemblies” and issuance of an Evaluation Report.

ICC-ES® Acceptance Criteria

ICC-ES (International Code Council Evaluation Service) as well as Underwriters Laboratories offer “Evaluation Reports” for technologies or solutions that the code language is not clear or alternative code compliant solutions are not clearly defined. ICC-ES

has “acceptance criteria for products and systems that are alternates to what is specified in the code, or that fall under code provisions that are not sufficiently clear for the issuance of an evaluation report. Acceptance criteria are developed by the ICC-ES technical staff in consultation with the report applicant and with input from interested parties; are usually the subject of open public hearings of the ICC-ES Evaluation Committee (made up entirely of Code Officials); and are approved by the Evaluation Committee after issues raised during the hearings are resolved.” These acceptance criteria are assigned a number preceded by “AC”.

Once compliance to the “AC” criteria is achieved, an Evaluation Report can be issued. The Evaluation Report details information about the “AC” criteria used for evaluation, the applicable sections of the code as well as tested system installation specifics. This tool aides Code Officials in properly identifying code compliant solutions not clearly defined by the code. AC101 as referenced previously, in conjunction with Evaluation Reports were used for flexible fire wrap systems for grease ducts to show code compliance prior to code inclusion.

AC179 – “Acceptance Criteria for Metallic HVAC Duct Enclosure Assemblies”

AC179 was revised in 2011 to include ASTM E2816 as the means for evaluating systems such as flexible wraps for ADS duct types (except grease ducts). As previously mentioned, there have been a few minor changes for clarity and

▲ Multiple ducts in close proximity to one another (left). Two ducts in close proximity to one another and surrounding service items (right).

“usability” to the E2816 standard since its origination. Manufacturers have now begun to test to this standard and Underwriters laboratories and Intertek Testing Services will be including these systems in their listing directories as means for evaluating ADS duct systems. In Addition to this, with AC179 in place, Evaluation Reports can now be obtained upon testing completion making the use of flexible fire wrap systems as alternative to gypsum shaft assemblies the easy, and technically sound choice for Design Professionals to specify, and Code Officials to approve.

Proven effectiveness

The proven effectiveness of this path to acceptance and later code inclusion for grease duct systems suggests the same evolution will take place for the other ADS duct systems discussed in this article. While tested, Listed and Labeled flexible ADS fire wrap systems today are widely accepted, this evolution will further expand the usage utilization of these systems and give Design Professionals and Code Officials a higher comfort level to specify and approve fire resistance rated duct assemblies as alternatives to fire rated shaft construction, providing greater opportunity for their benefits to be realized by the construction industry.

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Fire Rated Duct

Fire rated enclosure of duct located in exit passageway, protected with flexible wrap



Shaft Alternative for Air Distribution Systems (ADS)

By Sarah Brewer

Group Product Manager, Unifrax I LLC

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.

ADS ducts function under operational and emergency conditions

Multi-story commercial and residential buildings must utilize a variety of air distribution systems (ADS) to provide the necessary heating, cooling, and ventilating functions required to provide occupants with a tenable environment. These systems must meet minimum standards of performance and fire safety set by the building code for both

normal operating conditions and emergency fire situations. This is accomplished through a combination of code prescribed passive fire resistant building construction and active smoke control systems.

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

Shaft alternative: approval using alternate materials and methods

Fire rated duct enclosures, including flexible fire rated duct wrap systems are increasingly being utilized by design professionals and accepted by Authorities Having Jurisdiction (AHJ's) as a shaft alternative for unique job site conditions.



Example of duct with insufficient space to construct a shaft enclosure

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"¹ This option is further defined in Chapter 7 on Fire Resistance Rated Construction, Section 703.3 Alternate methods for determining Fire Resistance. Approvals for Alternative 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,

Duct enclosure system being prepared for testing per ISO 6944 under full scale duct application conditions



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 E 814 or UL 1479
- 5** Firestop system shall have an F and T rating equal to the fire resistance rating of the assembly being penetrated.²

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 the Fire Resistance Rating of the system. Meeting the pass/fail criteria of the standard verifies stability, integrity and insulation capabilities of the duct enclosure system and its ability to provide equivalent fire resistance to the code prescribed shaft. In addition, a through-penetration firestop system must be utilized to seal the duct penetration opening, which shall provide fire ratings (F)

and temperature ratings (T) equal to the duct enclosure and assembly penetrated (per ASTM E 814 criteria). 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 1. Grease Duct Enclosure Shaft Alternative Performance Criteria

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

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



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 assem-

bies (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.

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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

1. International Building Code 2006, International Code Council, Inc., 2006
2. International Mechanical Code 2009, International Code Council, Inc., 2009
3. BS 476: Part 24 (ISO 6944-1985), British Standards Institution, 1987

Sarah Brewer is a Group Product Manager for Unifrax I LLC with over 20 years experience in various engineering and marketing positions supporting the North American passive fire protection business. She is member of the ASTM E05 Task Group on Duct Enclosures, UL Standards Technical Committee on Grease Ducts and current President of the International Firestop Council (IFC) and Chairperson of its Duct Committee. She is also a member of the National Fire Protection Association (NFPA) and Society of Fire Protection Engineers (SFPE).

Save Space. Save Time. Save Lives.



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

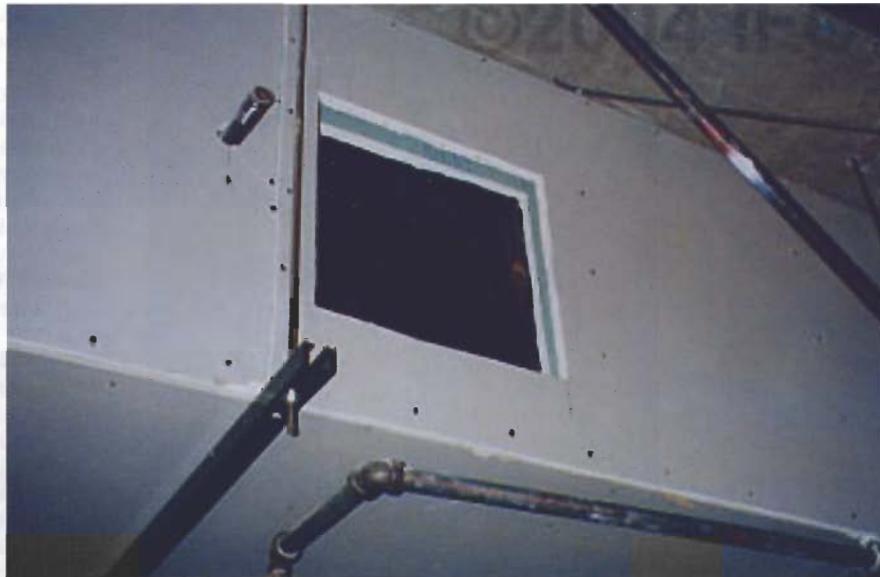
- Solutions for building design and complex job configurations
- Offers both fire and insulation performance; made in USA

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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*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.

By Brian P. Carnazza

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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 E2336 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 evaluating 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 pre-fabricated 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 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