

Full scale testing under application conditions



# Project Experience and New Codes Validate Grease Duct Wraps and Create Emerging Opportunities

Fire resistive grease duct enclosures including flexible grease duct wrap systems, have been commercialized for over 20 years. Demand for these alternate methods of fire protecting commercial kitchen exhaust ducts has increased as their technical merit was verified through full scale fire testing and application benefits defined through job site performance.

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**D**espite this multi-decade period of growing market acceptance, it is recent code changes that have provided the basis for even broader acceptance by industry design and regulatory professionals and is leading many to consider flexible duct wraps for other ventilation duct applications.

#### **Grease duct wrap benefits**

Prior to the year 2000, a few types of grease duct enclosure systems were already commercial and being used in the North American market, including field-applied grease duct enclosures and factory-built prefabricated grease ducts. Field-applied grease duct enclosures, better known as

*Duct with complex geometry and close to other service items*



flexible **grease duct wraps** are composed of high temperature fiber insulation blankets, typically encapsulated in a foil-scrim covering and supplied in rolls (a product form very familiar to the insulation industry). Upon introduction, designers and installers immediately recognized the potential space saving and labor saving benefits of utilizing this new method of fire protecting grease ducts. The *potential benefits* were translated in to *realized value* as industry professionals gained personal experience with grease duct wrap.

The most significant benefit flexible grease duct wraps provide is *building space savings*. The grease duct wrap can be applied directly to the duct surface and the systems are tested to permit installation at zero clearance to combustibles. This eliminates any need to incorporate additional air space between the duct and the enclosure. If a traditional shaft is utilized to protect the duct, mechanical codes mandate that 18" of air space (clearance) exist between the duct and a shaft enclosure, when constructed of combustible material. A 6" air space (clearance) must exist between the duct and the shaft enclosure when the enclosure is constructed of gypsum board. This clearance area cannot be utilized for any other

purpose (i.e. to run cable, pipe, etc.) and is lost space to an Architect or Engineer typing to maximize floor plan layouts or to Building Owners who desire to maximize billable real estate space. This space differential between grease duct wraps and gypsum board shafts is compounded when multiple ducts exist, since code requires each grease duct to be protected in a separate, dedicated enclosure.

The flexible, thin and lightweight duct wrap systems are inherently easy to handle and install. They conform to complex duct geometries and utilize less space which can resolve project issues when other building service items are in close proximity to the duct. This translates directly to contractor labor savings and timely project completion. The labor savings is significant enough that insulation contractors have been aggressively submitting project change orders requests in cases where the specification doesn't clearly define the use of grease duct wraps.

Utilizing standard grease duct construction in combination with field-applied flexible grease duct wrap provides the designer and installer with the most flexibility to address unexpected job site situations with fewer system changes or project delays.

Factory-built grease ducts must be pre-engineered during the mechanical system design stage and precisely manufactured to project drawings so that parts arriving on-site match field conditions. If changes to the duct configuration are necessary, it could require ordering of alternate duct system parts and potential delays.

Flexible grease duct wraps are made from high temperature insulation blanket, some which have recommended operating temperatures of 2000°F and melting points that exceed 2300°F. As a result, they are capable of withstanding long term operational conditions of commercial kitchen exhaust duct systems, which can be up to 500°F for extended periods of time and grease fire conditions that approach 2000°F with a comfortable safety margin. This material property safety margin provides designers and code authorities a comfort level with using wraps for grease duct fire protection.

Generic insulation materials that have not specifically been tested for this application should

**Table 1. Grease Duct Wrap Features & Benefits**

Feature	Benefit
Zero Clearance to Combustibles	Saves building space versus shaft – no mandatory 6"–18" air space between duct and enclosure
Flexible blanket product form	Able to conform to complex duct configurations
Thin, lightweight system	Easy to handle and install, reducing labor
Laboratory listings	Independent verification of fire performance and reference to test results, installation details
Fire tested on duct assemblies	Proven performance under application conditions
Standard Duct Construction	Flexibility to address job site issues without special system parts or potential delays
Wrap applied directly on duct	Simplifies installation on horizontal duct runs vs. construction of a horizontal shaft
High temperature insulation	Capable of withstanding operational (500°F) and fire conditions (2000°F)
Foil-scrim encapsulated	Aids material handling, resists tearing and moisture absorption

Evaluation Service Criteria:	Function:
Internal Fire Test	Contain internal grease fire within the duct
Engulfment Fire Resistance Test (including Through-penetration Firestop Test)	Prevent external fire from entering duct or passing through annular space opening between duct and the wall or floor
Fire Resistance Wall Test	Establish equivalency to shaft wall (ICBO only)
Non-combustibility Test	Core insulation doesn't support combustion
Durability Test	Effect of temperature cycling on insulation
<b>Other Property Tests:</b>	
Surface Burning Characteristics	Material doesn't exceed code prescribed flame spread and smoke developed ratings of 25/50

not be utilized. The operational temperature or use limit of many insulation materials is not high enough to withstand the fire exposure conditions of a kitchen grease fire. In fact, gypsum board used for most fire rated shafts is not recommended for applications with continuous elevated temperatures. One example of this is defined in the IMC, Section 602 covering Plenums, which does not permit the use of gypsum board if the air temperature exceeds 125°F. Due to the high temperature conditions and long operation time common for kitchen grease duct systems, it may be prudent for designers to specify grease duct wrap products that utilize insulation materials that can easily meet the application conditions without question.

**The early years: establishing code compliance**

During the time when alternate duct enclosure systems were emerging, mechanical engineers and contractors were able to obtain local approval of grease duct wraps from local code officials for individual projects based upon the Alternate Materials procedure permitted by the Code, often an onerous process. It takes time for new technologies to be widely embraced and accepted. The history behind grease duct wraps is no different. Work to obtain broader acceptance by incorporating new requirements within the code continued and the regulations evolved over time.

Regulation of commercial kitchen exhaust duct systems in North America most commonly falls under the International Mechanical Code (IMC), published by the International Code Council (ICC). (Additional recommended practices are captured in Standard NFPA 96, Ventilation Control and Fire Protection of Commercial Cooking Operations, which is typically referenced within project specifications). Requirements for commercial kitchen hood ventilation system ducts and exhaust equipment is located in Chapter 5: Duct Systems, Section 503.

The first edition of the IMC code was issued 2000, and Section 506.3.10 covered the application of Grease Duct Enclosures. Grease duct wraps and new types of grease duct enclosure systems were viewed as *alternates* to the code prescribed method of protection which was a fire rated shaft. Therefore, grease duct enclosures were incorporated in to the code, but categorized as an "Exception" and listed in a separate sub-paragraph. The language in the Exception paragraph that defines the performance criteria for grease duct enclosure systems was vague. This was due to the lack of a

North American standardized test method on fire resistive grease duct enclosures. Therefore, the test criterion was simply described as "...in accordance with a nationally recognized standard for such enclosure materials". (Similar language was incorporated in the Uniform Mechanical Code (UMC), published by the International Assn. of Plumbers and Mechanical Officials (IAPMO)). This provided the first ever basis for which Authorities Having Jurisdiction (AHJ's) could deem grease duct wrap systems *code compliant*, but still left the task of defining the appropriate performance criteria and the review of supporting manufacturer's product data to be done on a local basis.

To aid this process, the ICC Evaluation Service was established as an independent organization to conduct technical evaluations of building products, components, methods and materials. The evaluation process concludes with the issuance of a technical report called an Evaluation Service Report (ESR). Agencies use the ESR as guidance to help determine code compliance. Manufacturers use the ESR as evidence that their product meets the intent of the code. *This is especially useful if the product is new or the code requirements are not well defined.* ESR reports greatly aided the acceptance of grease duct wrap systems, especially since the 2000 and 2003 editions of the IMC code did not reference a fire test standard to which grease duct wrap systems should be tested.

For grease duct enclosures, ICC ES evaluations have been based upon acceptance criteria originally outlined by the Evaluation Service organizations for the three regional code bodies (SBCCI, BOCA, and ICBO) in existence prior to the formation of ICC and publication of the I-Codes. Differences between criteria developed by each resulted in two versions being used simultaneously within North America. The SBCCI criteria was based upon a few sections of UL1978 Standard for Grease Ducts, and resulted in qualification of single layer duct wrap systems, most commonly used in the Eastern USA. The ICBO criteria utilized a more severe internal fire test, which required two-layer duct wrap systems to qualify, and are most commonly used in the Western USA.

While the test criteria outlined by each region varied, all required the grease duct enclosure system to be tested under full scale *application conditions*. This type of application testing is not required for shafts. The technical basis for this is likely the fact the performance of shafts is verified with a fire test in a wall configuration. Therefore, when utilized as

Simple installation technique is easy to verify upon inspection



fire protection of grease ducts, four small shaft walls are constructed to enclose the duct. This configuration is assumed to provide equivalent protection to that of the flat, full size shaft wall. While code compliant, a fire rated shaft wall is *not a tested system* for grease duct enclosures.

### Evolution of grease duct enclosure code requirements

As grease duct enclosure systems continued to gain acceptance, there was an industry movement to develop a "nationally recognized test standard" specifically for grease duct enclosures that would harmonize the performance criteria and be acceptable for inclusion in the code(s). The culmination of this effort was ASTM E 2336 Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems, published in May 2004. The performance criteria mirrors ICBO AC101 and therefore results in two-layer grease duct wrap systems. ASTM E 2336 can also be used to evaluate factory-built prefabricated grease ducts as well as UL 2221 Standard for Tests for Fire Resistive Grease Duct Enclosure Assemblies, which was developed by UL specifically for factory-build grease ducts and utilizes similar performance criteria.

The new test standards were quickly embraced by industry and incorporated in the 2006 IMC. The words "...in accordance with a nationally recognized standard for such enclosure materials" were simply replaced with "in accordance with ASTM E 2336" or "in accordance with UL 2221". Similar language was also incorporated in to the 2004 Edition of NFPA 96. While change was made to only a few words, incorporation of the fire test criteria directly in the code has had a widespread impact on the market. There will be a transition period during which local jurisdictions are adopting the 2006 Edition of IMC when it will be unclear whether projects previously designed and bid under older codes will now have to comply with the newest performance criteria. All stakeholders in the project should be diligent to clarify with the local AHJ as to what criteria and duct wrap system are required. In some cases, work order changes for the duct wrap material may be necessary.

2006 IMC – Impact on Market:

- Harmonizes performance criteria across the USA

- Two-layer grease duct wrap systems used to comply with 2006 IMC/UMC
- Eliminates or reduces the need for an ESR report
- Design Listings from independent test labs suffice as test evidence and code compliance
- Contractors must be careful to install the grease duct wrap system appropriate for the edition of the IMC under which the project was permitted (pre-2006 vs. 2006); clarify with local AHJ before installing any single-layer UL1978 system.
- Engineers must plan adequate space for enclosure systems, especially as grease duct sizes have gotten larger.

In recent years, *alternate* grease duct enclosure systems have become widely accepted by regulatory authorities, and so, the evolution of the code continued. In the 2009 Edition of IMC due for publication in March, Section 506.3.10 has been reorganized in to three sections: shafts, field-fabricated grease duct enclosures, and factory-built grease ducts. This format eliminates the *Exception* designation for alternate grease duct enclosure systems and lists them as EQUIVALENT to fire rated shafts as a recognized method of fire protecting kitchen exhaust grease ducts. This code achievement is a significant milestone for the grease duct enclosure industry and for grease duct wraps.

### Emerging opportunities for duct wraps

The space savings, labor savings and design flexibility benefits offered by flexible *grease duct wraps* can also be realized for other *ventilation duct systems* that require fire protection. Potential duct types include: hazardous exhaust ducts; life safety ducts – including stairwell and elevator pressurization ducts and smoke extract ducts; toilet exhaust ducts, commercial dryer exhaust ducts and trash and linen chutes.

Industry acceptance of duct wraps for non-grease ventilation ducts is at a similar stage to where grease duct wraps were prior to the year 2000. Approvals by local AHJ's are already being granted based upon the Alternate Method procedure. Independent laboratory design listings are available that can demonstrate fire performance that meets the intent of the code. The specific value proposition duct wraps offer each duct type is in the process of being defined based upon recent project experiences. In addition, work is underway to develop appropriate fire performance criteria including a draft ASTM fire test standard for fire resistive ventilation duct systems. Once a "nationally recognized standard" is available, potential code change proposals to include *alternate* duct enclosures, including duct wrap systems can be considered for certain situations that require fire protected ducts.

Project testimonials and new codes have combined to validate grease duct wraps as a preferred method of fire protecting kitchen exhaust grease ducts. The experiences gained through the evolution of the grease duct enclosure application will guide the industry for ventilation ducts and hopefully shorten the time frame required to complete the process. If the widespread acceptance of the grease duct wraps by designers, installers and inspectors is any indication, then the future is bright for emerging opportunities for ventilation duct wraps.

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