Exhaust Ductwork Fire Protection

Exhaust Ductwork Fire Protection in Timber Multi-family Structures.

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Dryers and washing machines were involved in one out of every 22 home structure fires reported to United States fire departments between 2006 and 2010. Thousands of dryer related blazes occur every year in US home structures as a result of these common appliances.

In commercial multi-family residences, dryer exhaust ductwork requires passive fire protection. Unfortunately, the prescribed fire protection features do not dovetail with the construction practices used in multi-family structures, leaving room for non-compliance and safety concerns. Although, the recent advent of tested and listed fire-resistance-rated dryer exhaust duct wraps has prompted new solutions that have reverberated through the industry, driving change.

The Problem

How often is lint cleaned from dryer and exhaust ductwork? In 2010, there was an estimated reporting of 16,800 US home structure fires involving clothes dryers or washing units causing 51 deaths, 380 injuries and US$236 million in property damage. In fact, clothes dryers alone accounted for 92 percent or nearly 15,460 of the fires in these home structures, defined as single family dwellings, duplexes, manufactured homes, apartments, town-

houses, row-houses and condominiums.

While there are often multiple deficiencies culpable in fires, the root cause in approximately one-third of all residential dryer-related fires is simply a failure to properly clean and maintain the dryer unit and exhaust ductwork. This permits highly combustible lint and fibre to accumulate in the machine and ductwork.

Removing lint accumulation, one of the major sources of dryer fires, through simple, routine maintenance could likely prevent thousands of dryer-related fires every year. However, year after year fire statistics compiled over the past thirty years indicate consistent cleaning of the dryer and exhaust ductwork can become an afterthought in the hectic pace of everyday life. Regular cleaning and maintenance of dryer ductwork performed by tenants in afflicted residences, such as apartments and town-homes, may even be discouraged or frowned upon due to access or liability issues.

Multifamily Construction Practices

Timber is a lightweight, cost effective and energy efficient construction material. In fact, it is the only major renewable and sustainable building material. All of these characteristics make timber regularly used as the major structural component in the construction of low-rise apartments, townhouses, condominiums and residential units, also known as multi-family structures.

Timber-framed multi-family structures cover a vast spectrum of diverse residences, they can hold anywhere from two to 50 occupiable units, or more. They can be one-storey tall, or they can be upwards of four, depending on the construction type. These days, with consumer convenience paramount, particularly in competitive housing markets, it is quite common for residents to have their own personal washer and dryer located within their dwelling unit. In many instances, common laundry rooms have become a relic of college years past. Interestingly enough, the inclusion of dryers in these residences spurs both mechanical and somewhat ambiguous passive fire protection requirements, for routing dryer exhaust ventilation through the structure in a safe and effective manner.

Commercial structures, as a whole, have well-defined passive fire protection requirements, some of which are laid out in the International Building Code or jurisdiction-adopted alternative. One of the foremost fundamental and time tested notions of passive fire protection is compartmentation. Compartmentation is a building design feature that serves to inhibit the spread of fire and smoke from one unit to the rest of the structure for a given period of time, effectively providing life safety and property protection. Due to an ever present fire risk in any building, even structures utilising non-combustible framing materials, multi-family residential structures have fire-resistance requirements for all major building elements. For example, the 2012 International Building Code (IBC) dictates that timber-framed structures, three stories or under, must maintain one-hour fire-resistance-rated construction, partitioning, floors and tenant dwelling units. Rated construction functions to contain a potential fire to the unit of origin, permitting residents to safely exit the building while providing the fire department precious time to save the remainder of the structure.

Typical Dryer Configurations

Cars need an exhaust system to emit the by-products generated from the combustion reaction of gasoline, in a similar sense, so do clothes dryers:

$$Clothes_{Wet} + H_2O_{Liquid} \xrightarrow{HEAT} Clothes_{Dry} + H_2O_{Vapor} + Lint$$

Clothes dryers must emit lint particles and hot, moisture-laden air generated during the drying process. Due to safety, mould and cleanliness concerns, these contents are required to be expelled outdoors. The 2012 International Mechanical Code (IMC) requires dryer systems in commercial multi-family residences to utilise 100mm galvanised steel or aluminium metallic ductwork of a specified thickness for the exhaust system. This is unlike the short runs of flexible ductwork many are accustomed to in single family dwellings.

Most dryer and washer units are large, loud and obtrusive. Not surprisingly, it is common for most residences, including multi-family units, to have a laundry room or dedicated space with specialised exhaust connections to store these machines. In multi-family residences these exhaust connections typically penetrate interior, non-rated walls within the unit where the dryer is being held. This is typically the same wall adjacent to the back of the dryer. From here, exhaust ductwork is routed upward in the wall stud cavity until it reaches the bottom membrane of an IBC prescribed one-hour fire-resistance-rated floor/ceiling assembly.

In order to exhaust outside, ductwork must penetrate through the ceiling membrane of the fire-resistance-rated floor assembly, turn 90 degrees, and route horizontally within the rated assembly. The ductwork runs in-between the supporting timber trusses or joists, depending upon the floor system, until the ductwork reaches its termination point, outside of the building. These construction techniques permit the dryer exhaust ductwork to be shrouded within the existing construction, without additional effort or cost.

The unique dryer exhausting strategy employed in rated timber construction results in a membrane penetration. A membrane penetration is simply defined as an opening made through one side of a wall, floor or ceiling assembly. In the common field scenario described, code-required passive fire protection requirements become necessary when the ductwork penetrates through the gypsum board membrane of the rated floor/ceiling assembly.

The Code Requirements

Conventional practices in the design and construction of multi-family residences require dryer ductwork to penetrate and route through fire-resistance-rated assemblies. This clever design practice conceals ductwork from view at minimal cost and effort, but in the end, must still comply with code requirements. Membrane penetration protection is not explicitly stated in relation to dryer exhaust applications in the code. This coincides with ambiguity in compliance and enforcement. Even so, both the building and mechanical code have passive fire protection requirements to handle dryer exhaust ductwork.

Timber construction types employed in multi-family occupancies are required to have one-hour fire-resistance-rated construction by the International Building Code. This is specified in Table 601. Dryer exhaust ductwork that penetrates through a ceiling membrane of a rated assembly falls under

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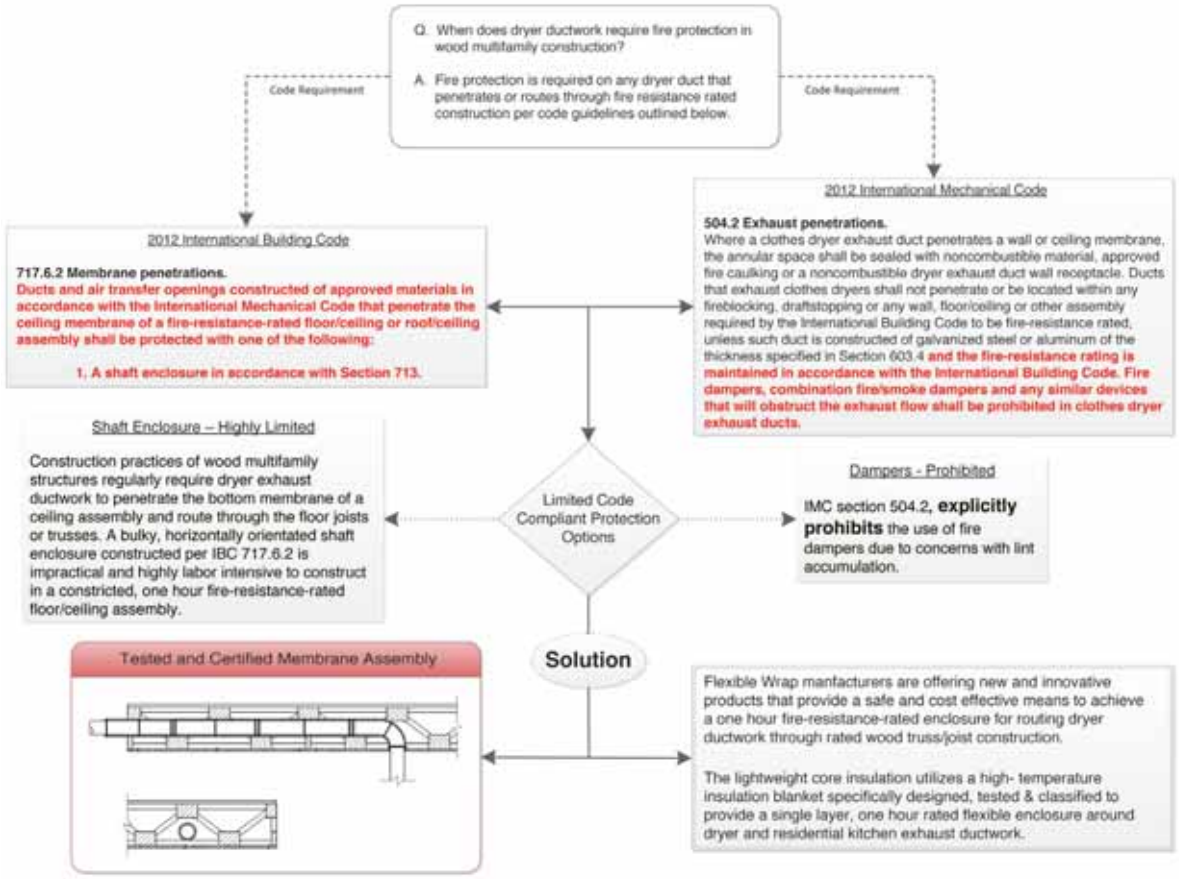
the guidance of IBC section 717.6.2 Membrane penetrations. Without restating the entire section, its intent in relation to dryer exhaust ductwork is straightforward. 717.6.2 states that fire protection is required in circumstances where ductwork penetrates through the ceiling membrane of fire-resistance-rated floor/ceiling construction. It also expresses the suitable means of protection, a shaft enclosure built around the ductwork. The section also offers some alternatives regarding dampers, but we will discuss that later.

So what's a shaft? A shaft enclosure is a common passive fire protection feature for safely routing mechanical equipment, like grease ductwork for instance, through buildings. Shafts in timber construction comprise gypsum board and timber studs, usually the same construction as a fire-resistance-rated wall. They create a rated box or enclosure around the ductwork, acting under the principles of compartmentation. Shafts do function well in providing passive fire protection. Although, they utilise valuable building space and are not easy to construct in tight areas, around complex ductwork configurations, or in horizontal orientations. All of which, come into play in the construction of multi-family residences. The code in a typical multi-family dryer installation dictates a bulky, horizontally constructed shaft running through trusses.

Clearly, a shaft enclosure will not fit the bill for the vast majority of timber-framed multi-family structures. A shaft enclosure cannot be constructed due to the limited space constraints within the floor assemblies. Alternatively, aesthetic considerations and design functionality often bar the implementation of an interior shaft or soffit, which would create a protrusion running through the occupancy. The only other alternative available is to route the exhaust ductwork outside the building, an option not commonly exercised in the field.

With shaft protection limited, a damper may appear to be an attractive code-compliant resolution. Unfortunately, this is not the case. The International Mechanical Code in section 504.2 Exhaust penetrations explicitly prohibits the use of fire dampers. The rationale behind this relates back to the major root cause of dryer fires, lint accumulation. In-line dampers have the potential to trap and allow lint to accumulate in the duct, creating a blatant fire hazard. This is why the mechanical code also prohibits any protrusions within dryer exhaust ductwork. Further on in section 504.2, the IMC goes on to reinforce the International Building Code shaft protection rationale stated in IBC section 717.6.2. Section 504.2 reaffirms dryer exhaust ductwork that penetrates a fire-resistance-rated assembly must maintain the rating of the assembly in accordance with the IBC; that is, a shaft enclosure.

It is clear the present industry construction guidelines do not address a realistic and attainable means of dryer duct fire protection in line with the construction practices used in multi-family residences. This leaves designers and installers at a cross-road. Without a simple, clear-cut solution the easiest answer at worst may leave penetrations unsealed and ductwork unprotected. Left unprotected, dryer penetrations result in untested membrane penetrations that compromise the designed fire-resistance-rating of the assembly. Additionally, there are valid concerns routing exposed ductwork, up to 25 ft., in close or direct contact with the combustible joists or trusses of the floor structure. See the code flowchart below.



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Duct Wraps, a Novel Solution

Fortunately, flexible duct wrap manufacturers have recognised the disparity between the current code language, traditional passive fire protection options, and multi-family building practices. In fact, this predicament is how duct wraps for other now popular applications came to fruition. Duct wraps acting as flexible, rated enclosures continue to solve field complications shaft construction cannot address. Flexible duct wraps are widely utilised as shaft enclosure alternatives in common applications such as commercial kitchen exhausts, air handling ductwork, chemical fume ductwork and others. They are recognised to create tangible value, saving customers money, installation time, and building space.

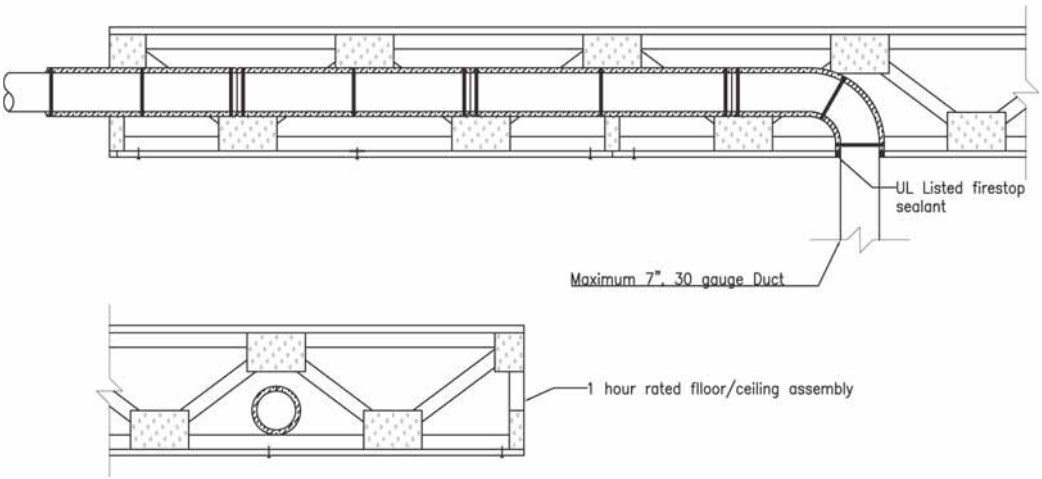
To address dryer exhaust fire protection, some duct wrap manufacturers have developed tested systems in conjunction with nationally recognised testing laboratories, like Underwriter's Laboratory, that reproduce common installation configurations. One such configuration is a dryer exhaust membrane penetration, which can be found online in the UL directory under the category name, XHEZ. A membrane penetration system provides a unique, application specific, fire-resistance-rating for both the ductwork and penetration. It also ensures the integrity of the fire-resistance-rating on the floor assembly. This coverage can only be achieved by testing actual insulated ductwork routed through a one-hour-rated floor assembly, as would be done in practice.

Membrane penetration systems are evaluated in multiple respects under standardised fire conditions:

1. **Insulation** – System must meet criteria which limits the temperature rise of the insulated ductwork.
2. **Integrity & Stability** – System must ensure ductwork remains intact and in place.
3. **Penetration** – System must have a penetration seal that remains intact with no flaming over the entire duration of the fire exposure; must also pass a hose stream test.
4. **Floor Assembly** – System must ensure the one-hour fire-resistance-rating of the floor assembly is unaffected.

Duct wrap systems provide a simple, yet effective way to enclose and provide separation between the ductwork and existing rated construction, permitting a true drop-in-place solution.

Tested membrane penetration assemblies in conjunction with relevant duct testing provides customers and code officials assurance that duct wrap products have been evaluated to industry-standard fire exposures. They also ensure routing dryer ductwork through the floor cavity has no detrimental impact to the designed rating of the floor. Dryer duct wrap products offered by manufacturers are also tailored specifically for dryer exhaust applications. Wrap manufacturers offer specialised thicknesses and material widths that reduce the amount of material scrap and offcuts for a simple, no-frills installation. All in all, flexible, field applied shaft alternatives are lightweight, thin and support installer friendly systems, but most importantly promote code compliant solutions that can take the heat. IFP



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For further 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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