



Minimizing Safety Risks in Commercial Kitchens with Factory-Built, UL Listed Grease Duct



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Grease Duct

Factory Built, UL Listed

Reducing Risk in Commercial Kitchen Applications

The design and installation of grease exhaust systems in commercial kitchens plays a critical role in the overall fire safety of these “high risk” facilities. When cooking-related fires occur in kitchens, the ductwork that transports smoke and exhaust to the outdoors can either help contain or accelerate unintended flames. Specifying an exhaust system that utilizes factory-built UL listed grease duct is one way that engineers can minimize these risks. This paper will explain the risk factors associated with conventional site-built grease duct installations and, alternatively, how specifying factory-built UL listed grease duct minimizes these risks and improves design flexibility.

Designers have two basic options when it comes to venting grease-laden vapor from Type 1¹ commercial cooking equipment, such as stoves and deep fryers. These venting systems can either be constructed of (1) field-welded rectangular duct, typically made of carbon steel, or (2) factory-built stainless steel round duct, available with key UL Listings. Field-welded systems are typically planned and measured in a sheet metal shop, and fitted and welded on the jobsite, making fabricators and installers solely responsible for the overall integrity of the duct system. Factory-built listed ductwork must conform to listing specifications that help ensure its performance in fire situations long before it ever leaves the factory. Quality control measures are defined by the listing agency and frequent factory follow-up procedures ensures the quality and integrity of the product.

While field-welded rectangular duct systems are more common, they offer few if any advantages over UL Listed, factory-built duct. Manufacturers of UL Listed pre-fabricated round duct have presented installed cost comparisons of both types of systems and the numbers demonstrate significant savings when factory-built grease duct is used—even though the equipment itself is more expensive. A comparison of field fabricated and fire wrapped (rectangular and round) duct vs. factory-built zero clearance UL Listed grease duct is below.

Fabrication & Fire Wrap Cost (Rectangular Duct)									
Duct Width	Duct Height	Length	Equivalent Duct Wt (lbs)	\$/lb	Estimate Fire Wrap Cost	Estimated Fabrication Cost	5 Access Doors	Install Cost	Total Install Cost
20	18	60	1136.2	\$11.50	\$16,606	\$11,000	\$1,500	\$14,000	\$43,106
Fabrication & Fire Wrap Cost (Round Duct)									
Duct Width	Duct Height	Length	Equivalent Duct Wt (lbs)	\$/lb	Estimate Fire Wrap Cost	Estimated Fabrication Cost	5 Access Doors	Install Cost	Total Install Cost
20	0	60	938.86	\$11.50	\$13,722	\$7,400	\$1,500	\$14,500	\$37,122
Factory Built ZERO Clearance Grease Duct (Round Duct)									
Duct Width	Duct Height	Length	Duct Wt (lbs) Incl. 3" Insulation	\$/lb	Estimate Fire Wrap Cost	Estimated Built Cost	5 Access Doors	Install Cost	Total Install Cost
20	0	60	1825	n/a	n/a	\$12,816	\$4,500	\$14,500	\$31,816

As demonstrated, factory-built grease duct has a greater unit cost, but lower total installed cost. Life cycle costs can also be lower due to ease of maintenance.

Installation Errors Impact Safety of Field-Welded Duct

Standard operating procedure is the primary reason field-welded systems are the go to option for commercial kitchen ventilation duct, albeit at a diminishing rate. Onsite installations lend themselves to a higher probability of field errors by installers and fabricators. Poorly lit jobsite conditions lead to imperfect welds which result in air leaks and compromise the integrity of the duct as a fire stop system. Such leaks are unlikely to go undiscovered until it is too late due to insufficient testing at the jobsite prior to start-up. Although the 2015 International Mechanical Code (IMC) does require that light or smoke tests be performed in accordance with IMC-506.3.2.5 Grease Duct Test, the actual enforcement of this code varies greatly. Even if a smoke or light test is performed, neither is very effective at revealing small leaks in the welding. Installers have also been known to tape over questionable weld spots in the ducts just to pass site tests.

¹TYPE I hoods are used over cooking equipment producing heat and grease laden effluent. These hoods require a fully-welded ducting system.

Water tests, which involve the use pressure washers to spray water at welded areas to check for leaks, is a far more reliable test. Some industry professionals believe this is the only suitable test method for field welded duct and have advocated that this type of testing be required on grease duct. Such testing would surely expose the vulnerability of field welded systems to leaks and reinforce the advantages UL Listed grease duct.

Access doors are another point of vulnerability in field welded systems. These doors, which provide access for periodic cleaning, are required by code but are often either improperly installed, resulting in leaks, or are forgotten altogether. The latter inevitably results in increased grease build-up inside the duct - a ready fuel source for any fire that happens to ignite. Grease build-up in kitchen hoods and ducts accounts for 21 percent of fires in restaurants and bars. According to the National Fire Protection Agency (NFPA), kitchen fires are responsible for millions of dollars in direct property damage, not to mention untold loss of business due to temporary or even permanent closure. ²

A 2015 ASHRAE Journal article³ cites investigations of numerous fires involving grease duct. Observations included:

- **Inappropriate sealing of the duct at the ceiling, which resulted in fire spread to the ceiling, attic and roof of a restaurant**
- **Loose fitting sleeve connections on vent piping allowed fire to escape the duct and go into an attic**
- **Improperly welded hood and duct connections allowed fire to spread beyond a restaurant duct system**
- **Ducts with imperfect welds led to grease accumulation and duct leakage**
- **Ducts installed with no access for cleaning**

Reducing Margin of Error with Factory-Built Duct

Specification of factory-built, listed duct products (UL1978-Grease Ducts) is the surest way for engineers to help owners significantly reduce these and other installation errors that so often lead to commercial kitchen fires. Factory-built systems are modular in design and assemble easily without the use of welding. Components fit together with bands that are designed with grooves that ensure perfect positioning and provide a visual aid for sealant application. Factory-built systems also include grease-proof and fire-tight access doors. Security Chimneys products even include a centering sleeve that stabilizes the tubes during assembly and covers joint grooves that might otherwise be exposed and trap grease contaminants. This sleeve offers additional support during installation, so that fewer workers are needed to hold the duct in position while the sealant is being applied.

Most importantly, the engineer can be sure that grease duct components are certified to UL 1978 “Grease Ducts for Restaurant Cooking Appliances” and UL 2221 “Standard for Tests of Fire Resistive Grease Duct Enclosure Assemblies” thus avoiding any weak links in the integrity of the system. Insurers also favor UL listed equipment, and may offer restaurant owners reduced premiums if their kitchen hood and exhaust systems are shown to meet UL Standards. Security Chimneys model CIX3Z is tested and Listed to the UL 2221 and UL 1978 Standards.

Circular Shape Enhances Efficiency, Function, and Safety

It's important that engineers and owners recognize the dynamic relationship between function and safety when it comes to grease duct. In a perfect world, most of the grease in an exhaust system safely exits out the stack in the form of vapor, while the rest drains freely into an easily accessible collection point near the range. But exhaust systems are typically not that efficient, and grease tends to collect on surface areas and in crevices, creating fuel for potential fire.

This is particularly true of rectangular duct. Air naturally flows in a circular pattern inside the duct; when this airflow collides with the flat surface of rectangular duct, turbulence is created. Turbulence not only impairs the efficiency of the exhaust system, it leads to increased build-up of grease in the corners of the duct, which are especially hard to clean.

Round duct, however, supports the circular flow of air inside the duct, so more grease laden vapor is removed. There is up to 45% less friction (per 100 ft) in a 15-inch-round than in a rectangular duct with the same cross sectional area and a 1,000-cfm airflow at 800 fpm. Also, any grease vapor that condenses before it can be exhausted will pool at the lowest point in a round duct and drain more efficiently than with flat surfaces. For this reason, round duct systems require less vertical slope (1/16-inch per foot) than rectangular duct which requires ¼-inch slope per foot, an added bonus since architects are frequently limited on the vertical space for duct.

²Based on data from the National Fire Protection Association.

³Horton, Doug. 2015. “Lessons learned from commercial kitchen fire investigations.” ASHRAE Journal: 18–26.

A More Straightforward Path to Required Clearances

Insufficient clearances between grease duct and combustibles (e.g. gypsum or plaster on wood or wood studs, fibrous tiles, etc.) is another contributing factor to commercial kitchen fires. NFPA 96, IMC, and the Uniform Mechanical Code (UMC) all require 18-inches of clearance between any single wall, uninsulated/unenclosed grease duct – rectangular or otherwise. If those clearances are not possible due to space constraints, alternative measures can be taken to achieve the required hourly fire rating. To meet this requirement, field welded rectangular duct must either be enclosed in a fire rated shaft or it can be wrapped in the field using a foil-faced insulation that meets ASTM E2336 if zero clearance is required.

The process is a bit more straight-forward with factory-built duct because it can be specified with an integral, double-wall insulated enclosure that is classified/listed to UL Standard 2221. Security Chimneys model CIX3Z components arrive at the jobsite with a zero clearance, 2-hour fire rating; no additional field wrap is required. This system also helps engineers ensure the overall integrity of the system since each component is designed to yield a fully enclosed, water-tight system.

Field wrapped rectangular duct takes up more space and is more irregular in appearance than double-wall, round duct. Aesthetically, round duct is sleeker and can even add architectural interest to an interior space. If expansions or renovations are required, the modularity of factory-built duct also makes it easier to modify while minimizing downtime or business closure.

Conclusion

Given the many advantages of factory-built grease duct over field-welded duct, it is only a matter of time before the latter will come to be the new standard for commercial kitchen applications. Traditional, site-built systems invite greater opportunity for installation errors that can and frequently do lead to commercial kitchen fires. Design engineers can help minimize these risks for owners by specifying factory-built systems that already incorporate the necessary fire-ratings required to meet applicable fire codes. These systems are easier to install, require no onsite welding, and are far less intrusive in terms of space and appearance than field welded systems.

Recent innovations have made these systems more fool-proof than ever by integrating features like centering sleeves that lend support and guidance during installation. Ultimately, factory-built grease duct systems are the more responsible choice for high risk commercial kitchen applications. Any additional design or material costs are easily offset by the insulation and field labor costs that these systems eliminate. The greatest value, however, may be the peace of mind that factory-built UL Listed grease ducts bring to an informed owner.



Always consult local code, Authority Having Jurisdiction, and appliance instructions when designing your Grease Duct vent system. To ensure a long-lasting trouble free operation, Grease Duct vent systems must be installed in accordance with the manufacturer's installation instructions.

For more information and literature on Grease Duct systems please visit:

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