

The Responsible Approach to Grease Duct

BEST PRACTICES for Conquering Risks and Cost Inefficiencies with Prefabricated Duct

This paper is written with regard to applicable codes and standards, and intended for use and application in the United States of America.



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Grease Duct



Firefighters may be the only ones who fully respect the catastrophic potential of grease duct in commercial kitchens. Even experienced restaurant owners and chefs may not realize how critical this seemingly every day mechanical component is for ensuring the safety and livelihood of a food service establishment. But the fact is, the majority of restaurant fires originate on the kitchen cooking appliance and flare into the kitchen exhaust system.[1] Leaks in field-welded grease ducts increase the risks of fire and also exacerbate the consequences. Unfortunately, most welded ductwork leaks.[2]

Prefabricated UL listed grease duct, an increasingly sought after alternative to traditional field-welded duct, significantly reduces the probability and consequences of grease duct leaks which can lead to fires. This paper, intended as a guide for commercial kitchen owners, designers, and installers, explains how pre-fabricated duct differs from field-welded grease duct, and why it is an overall safer and more cost-effective solution. It also identifies best practices for pre-fabricated grease duct selection, installation and maintenance.

Grease Duct: Purpose, Challenges & Risks

Grease duct is required on all Type 1 kitchen hoods (hoods used with appliances that produce grease and smoke during the cooking process), per the International Mechanical Code (IMC), Section 507. It connects to the kitchen hood and terminates at the exhaust fan, typically located on the building rooftop. In addition to providing a pathway for the exhaust of heat, smoke, and grease laden vapors from the building, grease duct is also essential for fire suppression. It should protect the surrounding environment from fires within the duct as well as protecting the duct's interior from fires that ignite outside the duct. However, if the grease duct lacks in integrity or stability, it can quickly turn into a fire transport system, putting an entire building at risk for rapid fire spread.

There are two basic options when it comes to grease duct: (1) field-welded rectangular duct, typically made of carbon steel, or (2) factory-built round duct made of stainless steel and/or galvalume, available with key UL Listings. In either case, grease duct is expected to comply with certain codes and standards to ensure safety. These include the National Fire Protection Association (NFPA), International Mechanical Code (IMC), and Uniform Mechanical Code (UMC).

NFPA 96, IMC, and UMC all require 18-in clearance between any combustible and any single-wall, unenclosed grease duct. If the required clearance is not possible due to space constraints, UL listed pre-fabricated duct products can be used to reduce necessary clearances down to zero. If the application requires zero clearance to combustibles, or a two-hour fire rating to meet the local code, or because the engineer/owner considers the consequences or probability of a fire to be high (***see Table 1***), UL listed, prefabricated grease duct can be used. This listing means that the duct has been tested to UL 1978 and UL 2221 for continuous temperatures of 500°F and intermittent temperatures of up to 2000°F for 30 minutes (a simulated internal fire) and two-hour fire rating (exterior engulfment) at zero clearance to combustibles.

High Risk High Consequence
Grease duct *shall* have a two-hour fire rating if required by local code and *should* have a two-hour fire rating if the engineer or owner believes the consequence or probability of fire is high.
Kitchens adjacent to/enclosed within highly populated facilities **(Two-hour, fired-rated duct is recommended.)** • Nursing Homes & Assisted Living facilities • Education & Childcare facilities • Mixed-use facilities with residences located above
Hotels & Hospitality Venues **(Two-hour, fired-rated duct is recommended.)** • Hotels • Stadiums & Arenas • Convention/Event Centers • Casinos • Music Clubs • Museums • Historic Districts & buildings
High Risk Applications **(Two-hour, fired-rated duct is recommended.)** • Culinary schools • Pizza and/or solid fuel ovens • Solid fuel appliance cooking • Buildings with rubber roofing • Buildings with outside vertical ducts

Table 1

There is no listing for field-welded duct, so meeting the above requirements is difficult and not especially reliable. Field-welded duct must either be enclosed in a fire-rated shaft or be wrapped in the field using a foil-faced insulation that meets ASTM E2336 if zero clearance is required. Despite these measures, field-welded ducts have shown signs of extreme thermal stresses when tested to UL Listed duct standards.[3]

UL Listed, zero clearance grease duct is a plug-and-play solution for applications that would otherwise require a fire-rated duct enclosure or ASTM E2336 wrapped welded duct. This type of listed duct is dual wall with 3-in of fiber insulation sandwiched between the inner and outer walls, so no field wrapping is required, saving a lot of time at the jobsite.

The fact that prefabricated grease duct does not require welding answers one of the biggest challenges facing food service owners and installers, the progressive scarcity of certified welders. There is an anticipated shortage of over 375,000 skilled welding professionals by 2023, based on data received from the Economic Modeling Specialists International and the American Welding Society.[4]

This is an especially critical problem for grease duct installations where leaky, welded ducts are often the root cause of the following:

- **Failed Inspections**
- **Unsightly damage and stains**
- **Problematic odors that may spread into adjacent spaces**
- **Rodent and pest infestation**
- **Mold**
- **Fires or exacerbation of fires**

Owners need to realize that all of the above issues can occur at any point during the life of the exhaust system. Since restaurants and cafeterias are usually contained within other types of properties (e.g. schools, healthcare facilities, hotels, hospitality venues, and mixed-use buildings) owners, patrons and occupants in other spaces may also be impacted.

Why Field-Welded Ducts Leak

What makes field-welded duct vulnerable to leaks? There are a number of reasons, beyond the shortage of skilled welding labor. A single kitchen exhaust system may contain hundreds of welds, many of which occur in cramped, poorly lit areas.

In an article for Engineered Systems magazine, one expert in commercial kitchen ventilation and fire analysis writes:

> *"In many routine visits to operating food service facilities and fire scenes, we have seen many leaking grease ducts and access doors, resulting in grease on top of hoods [….] on gypsum board ceilings, and permeating lay-in ceiling panels, thus providing flammable fuel for fires."* [5]

Joints, seams and penetration holes of grease duct all require continuous welds to prevent grease and residue from leaking into the interior. Workmanship, jobsite conditions and often unfamiliarity with codes make achieving a perfect installation a longshot. Codes require that ducts be leak tested, but most permit smoke or light testing methods which do not ensure a liquid tight installation, especially since dust and debris often settle into weld cracks during construction, obscuring light and smoke from being observed. Tests that rely on power washing are much more effective at revealing leaks, but in practice are more the exception than the rule.

Prefab Grease Duct: A Well-Rounded Solution

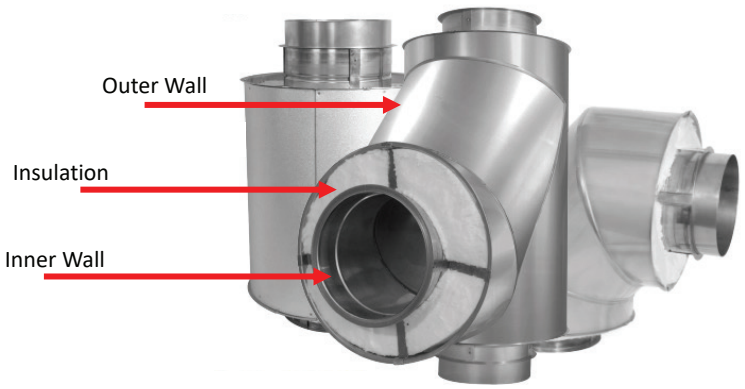
Prefabricated UL Listed duct counters the vulnerabilities associated with field-welded duct and provides value-added performance and longevity, including:

No leaks. Properly installed, prefabricated ducts don't leak, thanks to the fact that all welding is performed in a controlled and well-lit manufacturing environment by highly trained factory labor using laser technology. Innovations like DuraVent's liquid-tight sleeves also help ensure a leak-free installation.

Better drainage. Because most prefabricated grease duct is round instead of rectangular, grease efficiently drains to the bottom of the duct. Grease tends to pool and accumulate in the corners of flat duct, creating areas of build-up. Over time this accumulation can degrade exhaust performance and provide ample fuel for any fire that happens to ignite and spread into the duct.

Easier to clean. Round ducts are easier to clean because there are no hard to reach corners where grease tends to accumulate.

More energy efficient. Round duct creates less pressure drop throughout the exhaust system, and therefore requires less fan horsepower to draw exhaust air through the duct. Standard air duct calculation methods indicate a possible 26% friction reduction (per 100 ft) through a 14-in round duct compared to a rectangular duct of comparable sizing.



Better access. As a complete system, prefabricated duct systems arrive at the jobsite with properly spaced access doors to allow more thorough inspection and cleaning. Field-welded systems are notoriously lacking in sufficient access, and some access doors may be covered up with fire wrap.

Less slope. Because round duct drains better, it requires less slope per foot, one 1/16-in per foot, compared to 1/4-in per foot for rectangular duct. Where horizontal ducts exceed 75 feet in length, the required slope is 3/16-in per foot, compared to 1-in per foot for rectangular duct.[6] This reduces the amount of vertical space required for an installation. This slope exception is allowed for UL Listed duct per NFPA 96, IMC, and UMC codes.

Fewer field inspections. Prefabricated duct requires only one post-installation inspection. Field-welded fire wrapped duct must be inspected at three different points during the construction process—once after welding is complete, again after the first layer of insulation is applied, and finally after the second layer of insulation is applied.

Improved survivability. There are no requirements for how field-welded duct must hold up when exposed to extreme fire. And when they have been tested to standards similar to UL 1978 and 2221, the insulated ducts collapsed.[7] On the other hand, UL Listed prefabricated duct, has shown excellent survivability in real life fire events, reinforcing the validity of the Listing. A fire that took place in a restaurant in the historic Old Port neighborhood of Montreal is a good example. The fire, likely due to a spark from a wood-fired grill contacting some residual grease in the exhaust duct, quickly spread through the duct to the roof of the building, but fortunately stayed contained within the duct all the way to the chimney. Post fire inspection of the inner wall of the duct showed discoloration only, an indication of the extremely high temperature of the fire; however, the outer duct wall showed no stress at all. The liquid-tight duct system kept the fire from spreading to the building structure.[8]



Best Practices and Cost Saving Strategies for Pre-fabricated Duct

Prefabricated grease duct offers lifelong benefits, not to mention safety, that any well-informed owner would choose. What best practices apply to the design, installation and maintenance of this type of product? The question is, how can owners be sure they get the most cost-effective system without compromising safety or performance?

First and foremost, pre-design communication is key. This is a decision that will impact many throughout the life of the equipment, so everyone from the owner to the installer needs to be in the loop. In addition, the following best practices should be observed by designers, installers and owners.

Design Considerations

Many prefabricated grease duct systems are over-designed, which leads to inflated perceptions of the cost of these systems. Therefore, it is important that engineers select the lowest cost solution that meets the needs of the application and preferences of the owner.

Materials. Since stainless steel is the most expensive material option, designers should limit its selection to the interior of double-wall duct where it outperforms other materials in a highly corrosive grease environment.

Stainless steel outer walls provide no functional advantage over galvalume, which is 12-17% cheaper and can be painted to match the décor. However, some exposed applications will demand stainless steel, depending on space aesthetic and preferences of the owner (and sometimes the chef). Ducts that are hidden above ceilings or behind walls should always be galvalume.

To help guide engineers and owners through the materials selection process, DuraVent has developed a "Decision-Tree" that is included in our design guide for prefabricated duct found on www.duraventgreaseduct.com

Clearances. If your local fire and/or building code requires a two-hour rating or zero clearance duct you must select a UL 2221 listed duct. Your options for saving costs include downsizing the duct diameter, depending on the fan performance characteristics; and routing the duct to minimize the number of required elbows, access doors and customer parts.

If neither a 2-hour fire rating or UL 2221 listing is required, you may be able to reduce costs by mixing and matching insulation thicknesses and clearances to combustibles. In other words, if you have space around the duct, use it to offset the required amount of insulation. This can help save up 63% of the cost of the grease duct. (See Table 2)

Savings: 6% - 63%

Right Clearance

Design From		Design To	%
3" Insulation = 0" Clearance	→	2" Insulation = 1-2" Clearance	6-10%
3" Insulation = 0" Clearance	→	1" Insulation = 2-4" Clearance	16-19%
3" Insulation = 0" Clearance	→	1" Air gap = 4-8" Clearance	32-33%
3" Insulation = 0" Clearance	→	0" Insulation = 18" Clearance	62-63%

Justification
No UL 221, Clearance matches requirements

Notes
3" insulation = 0" Clearance, often over selected

Table 2

Slope. Be sure to take advantage of the reduced slope that prefabricated round duct affords. For duct run less than 75-ft you can save 3/16-in of vertical space per foot. For a 30-ft run of duct that gives you nearly a half foot of extra vertical space. (See Table 3)

	Length	Slope	Degree
Prefab	**< 75'**	**1/16" per 1'**	**.3**
	> 75'	**3/16" per 1'**	**.9**
Site Built	**< 75'**	**1/4" per 1'**	**1.2**
	> 75'	**1" per 1'**	**4.7**

Horiz. Run in Feet	Slope per foot	10 ft	20 ft	30 ft	40 ft	50 ft	60 ft	70 ft
Prefab Code Total Slope in "	0.0625	0.63	1.25	1.88	2.50	3.13	3.75	4.38
Site-Built Code Total Slope in "	0.25	2.50	5.00	7.50	10.00	12.50	15.00	17.50

Round 5.62" less @ 30'

Table 3

Opening size. Round duct requires more height than rectangular duct, so be sure there is enough structural space for the duct to pass through. And remember, this is not merely a matter of the pipe size; there must also be space for the connective fittings.

Be accurate. Designers should be sure that the measurements on the plans match up with the actual jobsite. Since variations are not uncommon, we recommend walking the jobsite with a measuring device to verify space dimensions prior to ordering.

Installation Considerations

One of the greatest advantage to using prefabricated grease duct is that it does not require expensive welding labor. Regular field labor should be more than capable of installing this type of duct with first-time guidance provided by the manufacturers' representative. (Do not hire expensive welders to spread sealant!)

Installers should read through the installation instructions for grease duct before beginning the project. In addition, DuraVent has created a series short instructional videos that demonstrate proper procedures for pipe joint assembly, working with variable length assemblies, and other basic installation practices. Installers should also make sure that there is ample room for inspectors and servicing agents to remove access doors, bearing in mind that such access is of no use if they are hidden behind drywall or installed in hard-to-reach areas.

Finally, the installer should advocate that a water test be used to ensure the duct system is liquid-tight. Light and smoke tests, while frequently used, are not reliable for ensuring a leak-free system. For more information about leak testing grease duct, see our white paper, Inspecting for Liquid Tight Requires Water Test.

Owner Considerations

Owners bear most of the liability for fire incidents and so it is incumbent upon them to make sure that best practices are followed. That means having at least a basic understanding of the codes that apply to grease duct in their particular jurisdiction, and what options are available to meet these codes. Owners should not assume that prefabricated duct will be used, despite the many advantages. While prefabricated duct has been around for many years, there remains an inclination not to change age-old specifications without some pressure from the owner or contractor.

Once the system is up and running, the owner should make sure a code compliant schedule for duct cleaning is in place and be vigilant about enforcement. Per the NFPA 96 Fire Code, the responsibility of inspection, maintenance and cleaning falls on the owner! Table 4 shows the appropriate inspection/cleaning frequency based on the type and volume of cooking.

Type or Volume of Cooking	Inspection Frequency
Systems serving solid fuel cooking operations	Monthly
Systems serving high-volume cooking operations such as 24-hour cooking, charbroiling, or wok cooking	Quarterly
Systems serving moderate-volume cooking operations	Semi-annually
Systems serving low-volume cooking operations such as churches, day camps, seasonal businesses, or senior centers	Annually

Table 4

Conclusion

Commercial kitchen owners need to understand the risks associated with grease duct applications. After all, this is an application that, by design, puts fuel within a few feet--if not inches--of a flame. A UL Listed prefabricated duct system is an owner's best line of defense against fire, catastrophic losses, business stoppage, injury or even death. Unlike field-welded systems, UL Listed prefabricated duct systems are tested to withstand the high temperatures associated with grease fires and maintain structural stability during a fire event. Installed properly, these systems do not leak.

By following the best practices described in this paper, owners, designers and contractors can be certain they have chosen responsibly.



[1] https://www.catersource.com/business-operations/trial-fire-improper-kitchen-exhaust-system-cleaning-worth-risk

[2] https://www.philackland.com/wp-content/uploads/2012/03/09-ducts.pdf

[3] Horton, Doug. 2015. "Issues and improvements," 42.

[4] https://www.kvue.com/article/money/business/american-welding-society-welder-shortage/269-62c243cd-24bd-4a45-80aa-f2efd5c54309

[5] https://www.esmagazine.com/articles/96926-issues-and-improvements-in-commercial-kitchen-exhaust-ducts

[6] Reduced slope reduction values are specific to DuraVent brand grease ducts and may not apply to other manufacturers' products.

[7] https://www.esmagazine.com/articles/96926-issues-and-improvements-in-commercial-kitchen-exhaust-ducts

[8] https://duravent.com/wp-content/uploads/2020/02/Case_Study_Grease_Duct_Montreal_10_08_19.pdf

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

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