able to sustain a duct fire and (2) prevent a fire within the duct from spreading to the rest of the building. Additionally, the fumes and smoke from the burning plastic will be exhausted to the outdoors, and not introduced into the occupied space. The plastic material also has the advantage of corrosion resistance. Metal ducts below a slab are susceptible to deterioration.

SECTION 506
COMMERCIAL KITCHEN HOOD VENTILATION SYSTEM DUCTS AND EXHAUST EQUIPMENT

506.1 General. Commercial kitchen hood ventilation ducts and exhaust equipment shall comply with the requirements of this section. Commercial kitchen grease ducts shall be designed for the type of cooking appliance and hood served.

❖ Section 506 addresses ducts serving Type I and II hoods installed over commercial cooking appliances.

506.2 Corrosion protection. Ducts exposed to the outside atmosphere or subject to a corrosive environment shall be protected against corrosion in an approved manner.

❖ Grease ducts and other ducts can deteriorate where exposed to the outdoors or to any indoor corrosive atmosphere. For example, ducts on a building rooftop and ducts run up a building exterior wall must be protected by an approved covering or encasement. Such protection must not create a fire hazard because of clearances to combustibles.

506.3 Ducts serving Type I hoods. Type I exhaust ducts shall be independent of all other exhaust systems except as provided in Section 506.3.5. Commercial kitchen duct systems serving Type I hoods shall be designed, constructed and installed in accordance with Sections 506.3.1 through 506.3.12.3.

❖ Because of the potential for spreading smoke, grease-laden air and fire from the kitchen exhaust system to other parts of the building, exhaust ducts serving Type I hoods are prohibited from interconnecting with any other exhaust ducts other than another Type I exhaust duct and then only where all four provisions of Section 506.3.5 are met (see commentary, Section 506.3.5).

Sections 506.3.1 through 506.3.12.3 address ducts used with Type I hoods and Sections 506.4 through 506.4.2 address ducts used for Type II hoods.

506.3.1 Duct materials. Ducts serving Type I hoods shall be constructed of materials in accordance with Sections 506.3.1.1 and 506.3.1.2.

❖ This section addresses the fact that grease ducts and makeup air ducts have different material requirements, which are prescribed in Sections 506.3.1.1 and 506.3.1.2, respectively.

506.3.1.1 Grease duct materials. Grease ducts serving Type I hoods shall be constructed of steel not less than 0.055 inch (1.4 mm) (No. 16 Gage) in thickness or stainless steel not less than 0.044 inch (1.1 mm) (No. 18 Gage) in thickness.

Exception: Listed and labeled factory-built commercial kitchen grease ducts shall be installed in accordance with Section 304.1.

❖ Commercial kitchen hood and duct systems are designed to resist structural failure in the event of a grease fire. Stainless steel and steel of the prescribed thicknesses are the only materials that can be used for field-fabricated, unlabeled grease ducts serving a Type I hood. The thicknesses specified for ducts are greater than those specified for hoods because the ducts are usually concealed in the building structure and because the likelihood of a fire occurring in a duct is greater than in the hood. Also, the intensity of a fire in a duct will be greater because of the concentrated fuel load and the airflow velocity created by the exhaust fan or the chimney effect of vertical ducts.

The exception allows a factory-built grease duct system to serve a commercial kitchen exhaust hood instead of a shop or field-fabricated, unlabeled grease duct system. A duct conforming to the requirements of this section must be tested and labeled by an approved testing agency and installed using the manufacturer's installation instructions. Because the code does not reference a safety standard to serve as a basis for the testing and labeling of grease ducts, it is important to determine that the duct was tested for use with the intended type of exhaust hood and cooking appliance(s), and was tested at the manufacturer's specified clearance to combustibles. A labeled duct may be installed with the clearance to combustibles that is specified in the manufacturer's installation instructions, if it was tested and labeled for that clearance. All components of the duct system, including the duct, fittings, access doors and joint materials, must be approved for use with the tested and labeled duct system. Each individual grease duct assembly or part must be marked with the following:

- The approved agency's identification;
- The manufacturer's specified minimum clearance (airspace) to combustible materials;
- The manufacturer's or private labeler's name or identifying symbol;
- The part or model number or designation; and
- The requirement to install in accordance with the manufacturer's installation instructions [see Figure 506.3.1.1(1)].

The manufacturer's installation instructions must also specify the type of exhaust hood and cooking appliance(s) that the grease duct can serve. Factory-built ducts offer installation alternatives to the requirement of Section 506.3.6 and are often used where grease ducts must pass through combustible construction assemblies. Some of these factory-built grease ducts are listed for zero clearance to combustibles and also have been shown through testing to provide the equivalent of a 2-hour fire-resistance-rated shaft enclosure [see Figure 506.3.1.1(2)].

c UL us LISTED

GREASE DUCT
A218

CLASSIFIED UL

GREASE DUCT
FOR USE IN GREASE DUCT ASSEMBLIES
CLASSIFIED IN ACCORDANCE WITH UL 2221
SEE UL FIRE RESISTANCE DIRECTORY
18LS

SELKIRK METALBESTOS.
Logan, OH Nampa, ID

Model Zero Clear - GREASE DUCT, CLASSIFIED AS AN ALTERNATE TO A 2 HOUR FIRE RESISTIVE SHAFT ENCLOSURE WITH A MINIMUM ZERO CLEARANCE TO COMBUSTIBLES.

Model Zero Clear – GREASE DUCT PART FOR RESTAURANT COOKING APPLIANCE. LISTED IN ACCORDANCE WITH UL1978 - STANDARD FOR GREASE DUCTS.

FLUE DIAMETER: 5" – 36" CLEARANCE TO COMBUSTIBLES: 0" (ALL SIZES)

FOR GREASE DUCT SYSTEMS INSTALLED WITHOUT A CONTINUOUS FIRE-RATED ENCLOSURE, AN EVALUATED THROUGH-PENETRATION FIRESTOP ASSEMBLY SHALL BE USED. SEE THROUGH PENETRATION FIRESTOP SYSTEM NO. C-AJ-7101 IN THE UNDERWRITERS LABORATORIES, INC. FIRE RESISTANCE DIRECTORY.

INSTALL AND USE ONLY IN ACCORDANCE WITH SELKIRK METALBESTOS GREASE DUCT INSTALLATION AND MAINTENANCE INSTRUCTIONS.

WARNING: RISK OF FIRE. DO NOT FULLY ENCLOSE WITHIN COMBUSTIBLE MATERIAL PLACED AT ZERO CLEARANCE TO ASSEMBLY.

Figure 506.3.1.1(1)
TYPICAL FACTORY-BUILT GREASE DUCT LABEL
(Photo courtesy of Selkirk, L.L.C.)

METALBESTOS.
ZERO CLEARANCE GREASE DUCT
AND FIRE-RATED INTEGRAL CHASE

Figure 506.3.1.1(2)
FACTORY-BUILT GREASE DUCTS
(Photo courtesy of Selkirk, L.L.C.)

506.3.1.2 Makeup air ducts. Make up air ducts connecting to or within 18 inches (457 mm) of a Type I hood shall be constructed and installed in accordance with Sections 603.1, 603.3, 603.4, 603.9, 603.10 and 603.12. Duct insulation installed within 18 inches (457 mm) of a Type I hood shall be noncombustible or shall be listed for the application.

❖ Makeup air ducts bring in outdoor air to the kitchen to replace the air exhausted by the hood. If they do not connect to a Type I hood or come within 18 inches (457 mm) of the hood, the ducts may be constructed of any material listed in Section 603 because there is little possibility of excess heat or fire being introduced into the duct. Where they are connected to the hood or come within 18 inches (457 mm) of the hood, they must meet the requirements of the sections listed, and the clearance for metallic ducts would have to be as required by Section 507.9. Since flexible ducts are combustible, they are not permitted to connect to the hood or come within 18 inches (457 mm) of a Type 1 hood [see Figures 506.3.1.2(1) and 506.3.1.2(2)].

Where duct insulation is located within 18 inches (457 mm) of the hood, it has the potential for exposure to excessive heat that could ignite the insulation. For this reason, the insulation must be composed of a noncombustible material or must be listed for the application.

506.3.2 Joints, seams and penetrations of grease ducts. Joints, seams and penetrations of grease ducts shall be made with a continuous liquid-tight weld or braze made on the external surface of the duct system.

Exceptions:

1. Penetrations shall not be required to be welded or brazed where sealed by devices that are listed for the application.
2. Internal welding or brazing shall not be prohibited provided that the joint is formed or ground smooth and is provided with ready access for inspection.
3. Factory-built commercial kitchen grease ducts listed and labeled in accordance with UL 1978 and installed in accordance with Section 304.1.

❖ The joints and connections of an exhaust duct must be welded or brazed liquid tight to prevent grease and residues from leaking from the duct interior. This would prohibit the use of sheet metal locking joints, rivets, screws or any mechanical connecters, except as stated in the exceptions to this section. Joint surfaces must be smooth to facilitate cleaning and to prevent the accumulation of grease. Penetrations of grease ducts would include fire suppression system piping and nozzles.

Exception 1 recognizes the existence of penetration sealing devices that are specifically listed for that application. These devices would have to rely on some type of noncombustible or heat-tolerant gasket or compression seal.

Exception 2 allows internal welded or brazed joints instead of external welded or brazed joints only where those joints would not promote the collection of grease and only where they are readily observable.

Exception 3 requires that factory-built grease ducts be listed and labeled in accordance with UL 1978, a consensus standard for factory-built grease ducts. The construction and assembly of factory-built grease ducts are regulated by the product listing and therefore are not subject to the provisions of this section. For example, factory-built grease duct sections are joined with proprietary mechanical joints and cannot be welded or brazed.

506.3.2.1 Duct joint types. Duct joints shall be butt joints or overlapping duct joints of either the telescoping or bell type. Overlapping joints shall be installed to prevent ledges and obstructions from collecting grease or interfering with gravity drainage to the intended collection point. The difference between the inside cross-sectional dimensions of overlapping sections of duct shall not exceed 0.25 inch (6 mm). The length of overlap for overlapping duct joints shall not exceed 2 inches (51 mm).

❖ The provisions of this section intend to achieve liquid-tight joints that will not collect grease. Telescoping overlap joints must be installed so that the grease drainage flows from the duct with the smaller internal diameter to the duct with the larger internal diameter. This will prevent the duct edge from creating a dam in the grease flow, especially in horizontal ducts (see Figure 506.3.2.1).

506.3.2.2 Duct-to-hood joints. Duct-to-hood joints shall be made with continuous internal or external liquid-tight welded or brazed joints. Such joints shall be smooth, accessible for inspection, and without grease traps.

Exceptions: This section shall not apply to:

1. A vertical duct-to-hood collar connection made in the top plane of the hood in accordance with all of the following:
   1.1. The hood duct opening shall have a 1-inch-deep (25 mm), full perimeter, welded flange turned down into the hood interior at an angle of 90 degrees from the plane of the opening.
   1.2. The duct shall have a 1-inch-deep (25 mm) flange made by a 1-inch by 1-inch (25 mm by 25 mm) angle iron welded to the full perimeter of the duct not less than 1 inch (25 mm) above the bottom end of the duct.
   1.3. A gasket rated for use at not less than 1,500°F (815°C) is installed between the duct flange and the top of the hood.
   1.4. The duct-to-hood joint shall be secured by stud bolts not less than 0.25 inch (6.4 mm) in diameter welded to the hood with a spacing not greater than 4 inches (102 mm) on center for the full perimeter of the opening. All bolts and nuts are to be secured with lockwashers.
2. Listed and labeled duct-to-hood collar connections installed in accordance with Section 304.1.

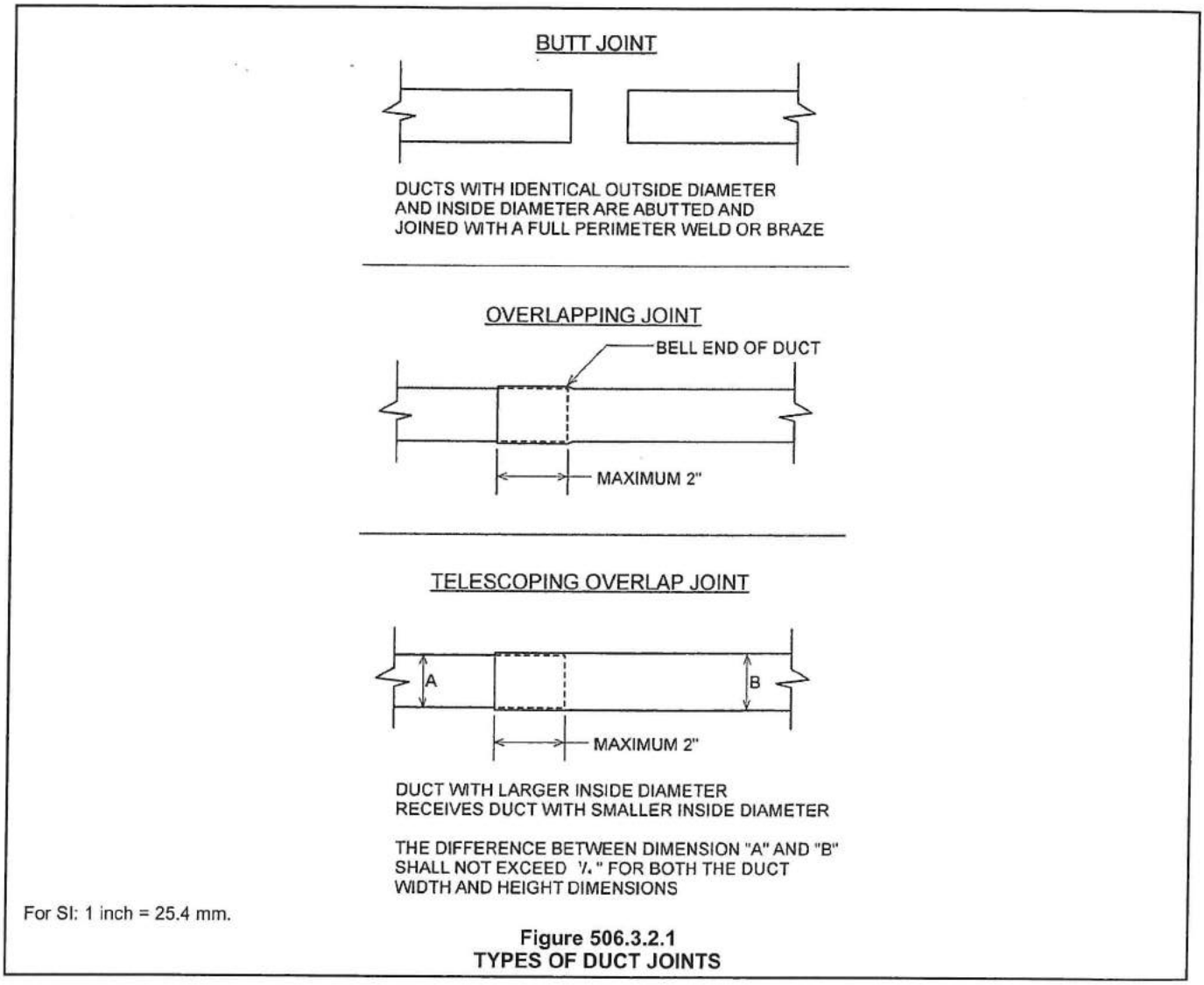


Figure 506.3.2.1
TYPES OF DUCT JOINTS

❖ This section applies to Type I hoods only. Grease ducts and hoods must be liquid tight; therefore, welded or brazed joints are required. It is often difficult to weld or braze the joint between a hood and its duct(s) because of lack of access to the juncture and space constraints caused by structural members. Either the hood or the duct is installed first and the companion element (hood or duct) is then joined to the already installed component. This typical sequence of construction is what makes it difficult to weld or braze hood-to-duct joints and is the reason for the two exceptions to this section. Both exceptions refer to mechanical joints designed to be mechanically strong and liquid tight. These kinds of joints are considered to be functionally equivalent to welded or brazed joints (see Figure 506.3.2.2).

506.3.2.3 Duct-to-exhaust fan connections. Duct- to-exhaust fan connections shall be flanged and gasketed at the base of the fan for vertical discharge fans; shall be flanged, gasketed and bolted to the inlet of the fan for side-inlet utility fans; and shall be flanged, gasketed and bolted to the inlet and outlet of the fan for in-line fans.

❖ Joints between grease ducts and exhaust fans must be liquid tight but need not be welded or brazed. The joints must be readily disassembled to allow for maintenance and repair or fan replacement; therefore, mechanical joints consisting of flanges, gaskets and bolts are used. Bolts are not required for flanged joints under vertical discharge (upblast) fans because fan curbs would make the bolts inaccessible. Grease ducts are supported independently of vertical discharge fans and the fan flange rests on the duct flange, relying on the flange gasket and the fan weight to maintain a seal.

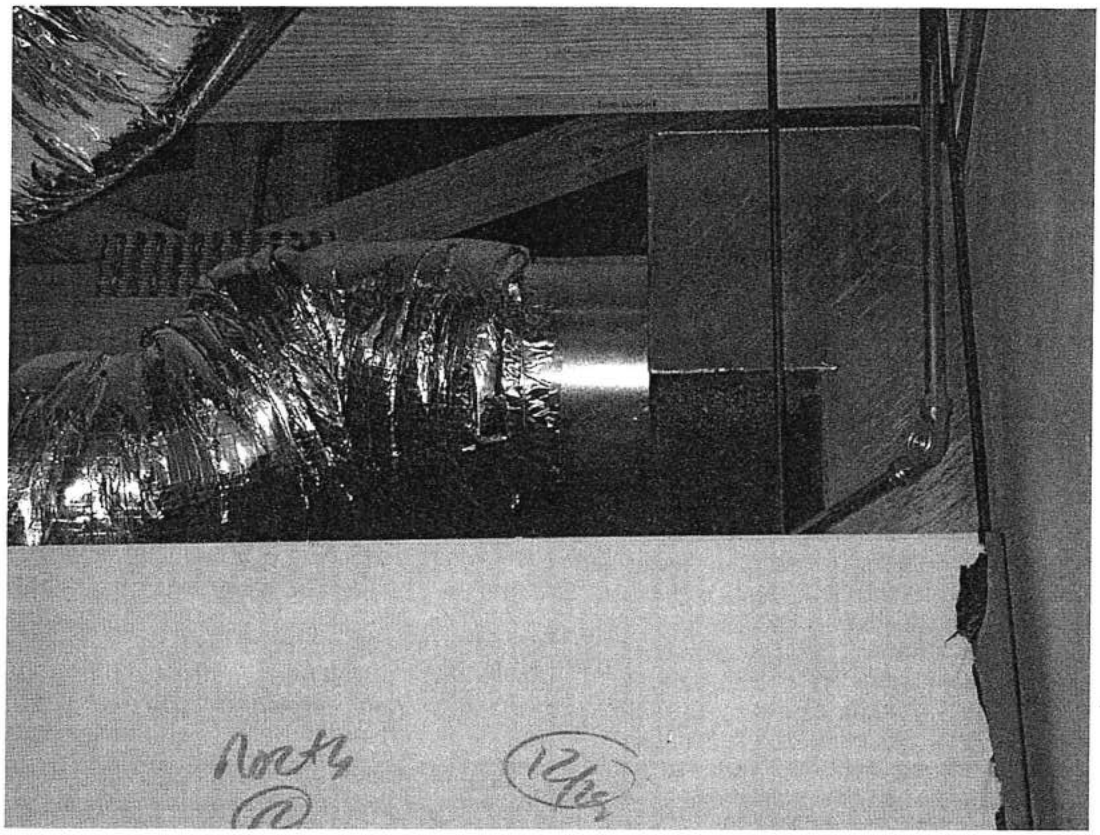


Figure 506.3.1.2(1)
PROHIBITED INSTALLATION OF FLEXIBLE AIR DUCT CONNECTING TO A MAKEUP AIR PLENUM ABOVE A TYPE I HOOD

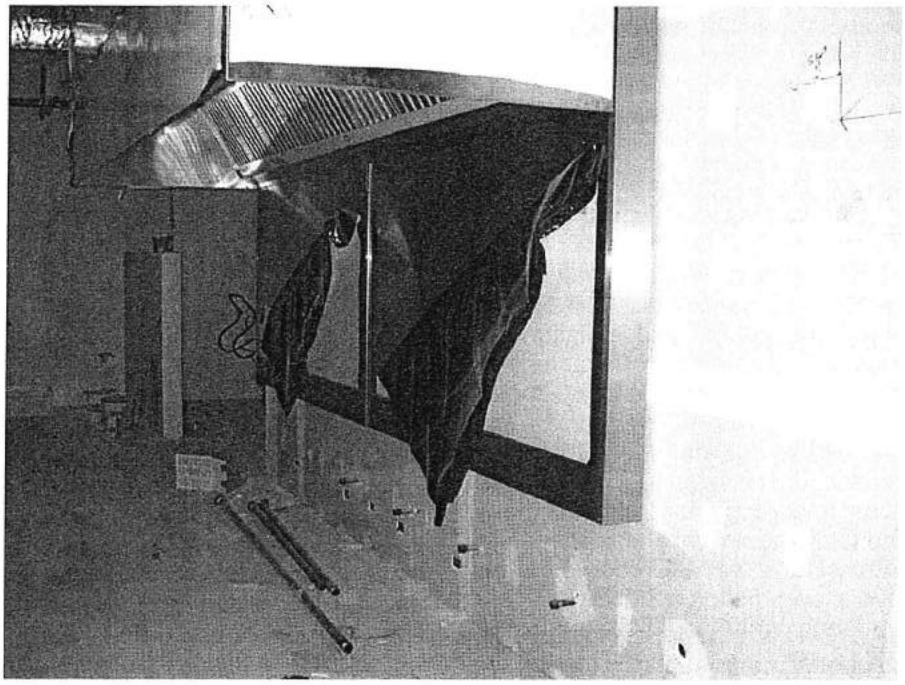
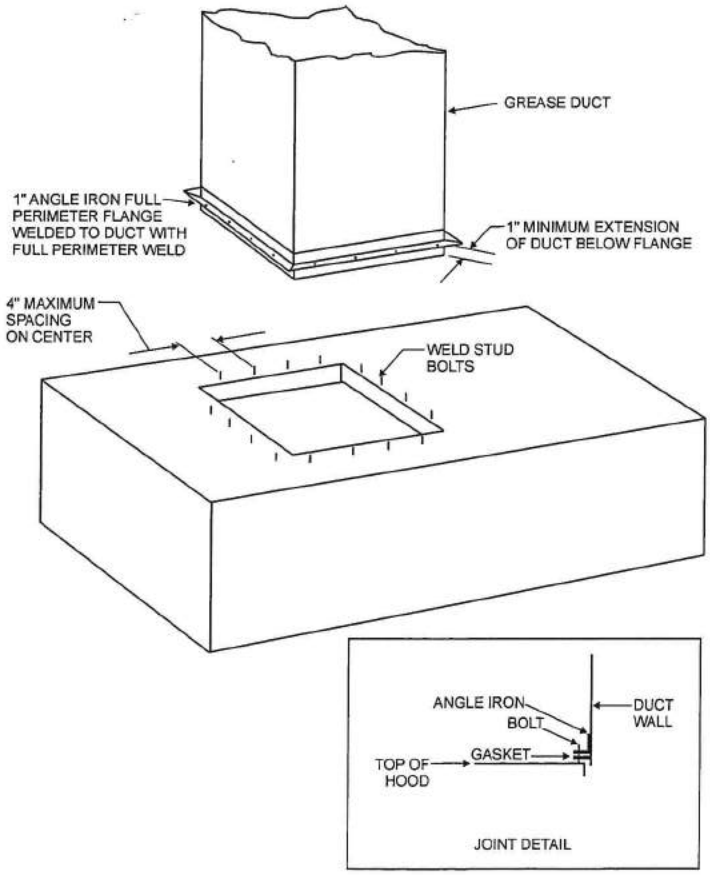


Figure 506.3.1.2(2)
BACKWALL MAKEUP AIR PLENUM



For SI: 1 inch = 25.4 mm.

Figure 506.3.2.2
DUCT TO HOOD JOINTS

506.3.2.4 Vibration isolation. A vibration isolation connector for connecting a duct to a fan shall consist of noncombustible packing in a metal sleeve joint of approved design or shall be a coated-fabric flexible duct connector listed and labeled for the application. Vibration isolation connectors shall be installed only at the connection of a duct to a fan inlet or outlet.

❖ Vibration isolation is not required by the code, but is regulated if installed in an exhaust duct system. To avoid the potentially hazardous accumulation of grease and the installation of ignition-prone materials, the code prescribes the use of an approved metal sleeve joint with noncombustible packing or an approved coated-fabric flexible duct connector for vibration isolation in grease duct systems. These joints must prevent the escape of grease, exhaust flow, smoke and fire. The joints do not resemble the fabric isolation joints typically found in HVAC ductwork. The packed metal sleeve allows motion in only one direction and the flexible fabric connector allows motion in all directions.

Vibration-isolation joints are intended for use only where necessary to control noise and vibration, which means only at the point of connection to exhaust fans. Vibration-isolation joints are not intended for and must not be used for joints in duct runs.

506.3.2.5 Grease duct test. Prior to the use or concealment of any portion of a grease duct system, a leakage test shall be performed in the presence of the code official. Ducts shall be considered to be concealed where installed in shafts or covered by coatings or wraps that prevent the ductwork from being visually inspected on all sides. The permit holder shall be responsible to provide the necessary equipment and perform the grease duct leakage test. A light test or an approved equivalent test method shall be performed to determine that all welded and brazed joints are liquid tight. A light test shall be performed by passing a lamp having a power rating of not less than 100 watts through the entire section of duct work to be tested. The lamp shall be open so as to emit light equally in all directions perpendicular to the duct walls.

A test shall be performed for the entire duct system, including the hood-to-duct connection. The ductwork shall be permitted to be tested in sections, provided that every joint is tested.

❖ The intent of this section is to prescribe a method of testing grease ducts to check that all welded and brazed joints and seems are sealed liquid tight. Note

that while this section is a subsection of Section 506.3.3 in the first printing of the code, this is an errata item and this section will be renumbered as Section 506.3.2.5 in subsequent printings of this code.

A light test is the most cost-efficient and effective method to locate any defects in welded or brazed grease duct installations and has been successfully used for for many years. Leaks in grease ducts can lead to the passage of grease to surrounding areas of the ductwork and the building components, thus creating a potentially dangerous fire condition. This potentially dangerous condition can be eliminated by performing this simple test. The typical permit holder/installer needs a ladder, drop light and cords to complete this test. Note that the light test is not the only test permitted since the code permits the authority having jurisdiction to approve other equivalent test methods. However it is important to note that SMACNA has no criteria for testing this type of installation. It can be very dangerous to pressurize ductwork of this nature, mostly due to the size. Even a smoke test requires some pressure, and even then, one cannot be ensured of the even distribution of smoke throughout the entire system. Using the light test also allows for the grease duct to be tested as the sections of duct are completed.

506.3.3 Grease duct supports. Grease duct bracing and supports shall be of noncombustible material securely attached to the structure and designed to carry gravity and seismic loads within the stress limitations of the *International Building Code*. Bolts, screws, rivets and other mechanical fasteners shall not penetrate duct walls.

❖ Proper support of the duct system requires designing for the weight of the duct as well as for dynamic loads caused by vibrations. Support is necessary for proper alignment of the duct system and avoidance of stresses that could lead to joint failure. A sagging duct will increase internal resistance to airflow, reduce the efficiency of the system and lead to the hazardous accumulation of grease. As with piping systems, ducts and ductwork systems that are improperly supported will deteriorate structurally and functionally.

Support for grease ducts must be installed in accordance with Section 603.10 and the seismic provisions of the IBC. Support spacing is limited to not more than 10 feet (3048 mm) between supports because of the inability of commonly used duct materials to resist deflection at larger intervals. This spacing criterion is primarily applicable to rigid ducts constructed of sheet metal; some duct configurations and duct materials will require shorter spacing intervals. For example, some duct materials would require support at each joint. The SMACNA *HVAC Duct Construction Standards—Metal and Flexible* contains information for choosing support systems for ducts. Additionally, the IBC could require that the duct support system be designed to resist earthquake loads, depending on the location and use of the building.

If duct hangers and supports are not used and a portion of the building structure is used to support the duct, the support system must be designed by a registered professional engineer or architect to comply with the IBC. Duct hangers must be noncombustible, approved for the application and designed for the loads to be carried. Fasteners must not penetrate ducts because of the liquid-tight design of grease ducts.

506.3.4 Air velocity. Grease duct systems serving a Type I hood shall be designed and installed to provide an air velocity within the duct system of not less than 500 feet per minute (2.5 m/s).

Exception: The velocity limitations shall not apply within duct transitions utilized to connect ducts to differently sized or shaped openings in hoods and fans, provided that such transitions do not exceed 3 feet (914 mm) in length and are designed to prevent the trapping of grease.

❖ The cross-sectional area of a grease duct system serving a Type I hood must be sized so that the exhaust air velocity is maintained at 500 feet per minute (2.5 m/s) or higher. This has been changed from the previous edition of the code based on a recent ASHRAE research project (RP-1033) conducted by the University of Minnesota, which found that duct velocities below 1,500 feet per minute (7.6 m/s) did not result in an increase in the rate of grease deposition on the walls of the ductwork. The results of this ASHRAE research project were used to substantiate a change to the 2001 edition of NFPA 96, which also lowered the minimum duct velocity to 500 feet per minute (2.5 m/s).

The exception allows the velocity of exhaust flow to fall below the specified velocity only in duct transition fittings that are necessary to connect grease ducts to hoods and fans. Because the shape of the transition fitting differs from that of the duct, the flow characteristics in the fitting will be different. This deviation in velocity is tolerable for small distances, especially at hood and fan connections.

506.3.5 Separation of grease duct system. A separate grease duct system shall be provided for each Type I hood. A separate grease duct system is not required where all of the following conditions are met:

1. All interconnected hoods are located within the same story.
2. All interconnected hoods are located within the same room or in adjoining rooms.
3. Interconnecting ducts do not penetrate assemblies required to be fire-resistance rated.
4. The grease duct system does not serve solid fuel-fired appliances.

❖ A grease duct system serving a Type I hood may interconnect with, or share common components with, another grease duct system serving a Type I hood only

as specified in this section. Grease duct systems serving Type I hoods cannot, under any circumstances, interconnect with, or share common components with, any building ventilation or exhaust system other than another grease duct system.

Although Section 506.3.10 limits a shaft to enclosing a single grease exhaust duct system, Section 506.3.5 does not prohibit multiple grease exhaust ducts from connecting to a common trunk, riser or system if the additional safety conditions are met. Interconnected hoods must be located within the same story and within the same room or in adjoining rooms, and the interconnecting grease ducts that join hoods to the common exhaust duct must not penetrate fire-resistance-rated assemblies. A grease duct system serving a solid-fuel- fired appliance, such as a barbecue smoking pit or a wood-fired pizza oven, cannot be interconnected with other grease hood exhausts. The intent of this section is to prevent fire from spreading from one system to another through the common portion shared by the hood systems and to prevent fire from spreading to other stories or fire areas (see Section 507.2.4).

506.3.6 Grease duct clearances. Grease duct systems and exhaust equipment serving a Type I hood shall have a clearance to combustible construction of not less than 18 inches (457 mm), and shall have a clearance to noncombustible construction and gypsum wallboard attached to noncombustible structures of not less than 3 inches (76 mm).

Exception: Listed and labeled factory-built commercial kitchen grease ducts and exhaust equipment installed in accordance with Section 304.1.

❖ The required 18-inch (457 mm) distance from exhaust duct surfaces to combustible materials applies to exposed and concealed ducts and those enclosed in shafts (see Figure 506.3.6). Although normal operating temperatures in a hood and duct system might be relatively low, especially compared to temperatures encountered in a fire, combustibles near the duct system become more susceptible to ignition because of the long-term exposure to even this moderate heat and can be ignited by the radiant or convective heat given off by the duct system surfaces during "normal" hood and duct system operation. Note that the required clearance to combustibles for a Type I hood is also 18 inches (457 mm); however, this section only applies to the grease duct. The clearance requirements for a Type I hood can be found in Section 507.9 (see commentary, Section 507.9).

The clearances from the ducts to vertical and horizontal surfaces can be reduced in accordance with the provisions of Section 308.

In the context and application of the code in general, a composite material such as gypsum wallboard (drywall, sheetrock, etc.) is considered combustible (see the definition of "Noncombustible materials"); however, this section treats gypsum wallboard as a noncombustible material and only requires a 3-inch (76 mm) clearance. Remember that gypsum wallboard installed on a combustible substrate or on wood studs does not cause the wall to be considered as a noncombustible assembly, and the 18-inch (457 mm) minimum clearance still applies. The classification of combustible and noncombustible materials is not changed by the use of fire-retardant-treated wood products or fire-rated (Type X) gypsum wallboard.

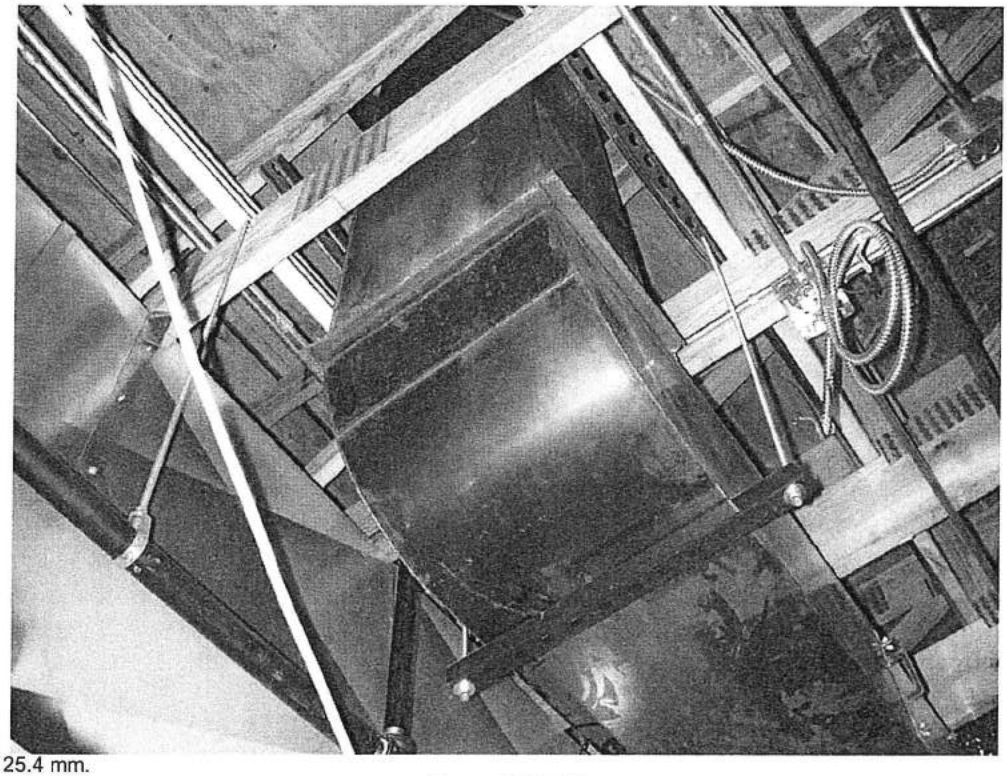
The exception states that listed and labeled factory-built grease ducts installed in compliance with Section 304.1 are not subject to the clearance requirements of this section. In buildings of combustible construction with commercial kitchens, the lesser clearances required for listed and labeled, factory-built grease ducts are a feature offering an alternative to field-constructed ducts that require the 18-inch (457 mm) clearance. Factory-built grease ducts have minimum clearance requirements similar to the clearances required for factory-built chimneys and some of these ducts have been tested for zero clearance to combustibles [see Figures 506.3.1.1(1) and 506.3.1.1(2)].

506.3.7 Prevention of grease accumulation in grease ducts. Duct systems serving a Type I hood shall be constructed and installed so that grease cannot collect in any portion thereof, and the system shall slope not less than one-fourth unit vertical in 12 units horizontal (2-percent slope) toward the hood or toward an approved grease reservoir. Where horizontal ducts exceed 75 feet (22 860 mm) in length, the slope shall not be less than one unit vertical in 12 units horizontal (8.3-percent slope).

❖ Sections of ducts serving Type I hoods must be constructed with the code-prescribed slopes and installed without forming any dips, pockets or low points that are capable of collecting grease or residue. Sloping the duct back toward the exhaust hood or to an approved grease-collection reservoir will minimize the retention of grease in the duct system. A greater slope is necessary for long duct runs to encourage grease to flow to the collection points. Without adequate slope, grease could congeal before reaching the collection point, thus forming dams and allowing significant buildup (see Figure 506.3.7).

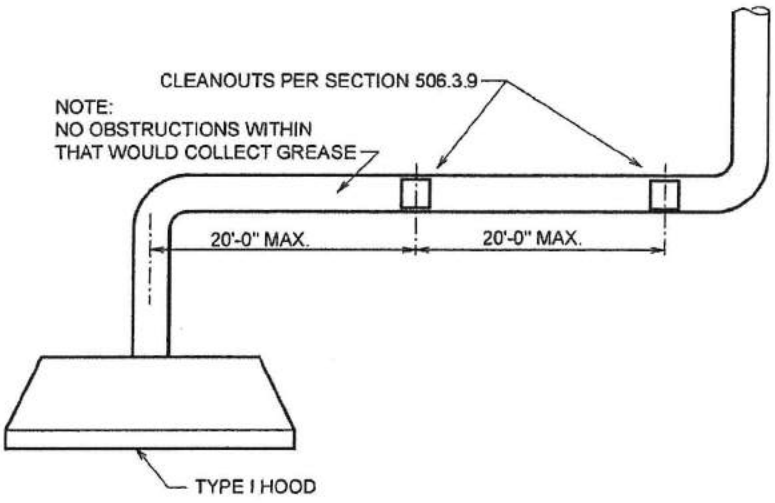
506.3.8 Grease duct cleanouts and other openings. Grease duct systems shall not have openings therein other than those required for proper operation and maintenance of the system. Any portion of such system having sections not provided with access from the duct entry or discharge shall be provided with cleanout openings. Cleanout openings shall be equipped with tight-fitting doors constructed of steel having a thickness not less than that required for the duct. Doors shall be equipped with a substantial method of latching, sufficient to hold the door tightly closed. Doors shall be designed so that they are operable without the use of a tool. Door assemblies, including any frames and gasketing, shall be approved for the purpose, and shall not have fasteners that penetrate the duct. Listed and labeled access door assemblies shall be installed in accordance with the terms of the listing.

❖ To maintain the integrity of grease duct systems, openings into the systems are limited to those necessary for proper operation and maintenance. Operation and maintenance are closely related. Operation creates



For SI: 1 inch = 25.4 mm.

Figure 506.3.6
PROHIBITED INSTALLATION OF A GREASE DUCT (Less than 18-inch clearance to combustibles)



NOTE: HORIZONTAL SYSTEM ≤ 75' IN LENGTH
SLOPED ≥ 1/4:12 (2-PERCENT SLOPE) TOWARD
HOOD OR APPROVED GREASE RESERVOIR

HORIZONTAL SYSTEM > 75' IN LENGTH
SLOPED ≥ 1:12 (8.3-PERCENT SLOPE) TOWARD
HOOD OR APPROVED GREASE RESERVOIR

For SI: 1 foot = 304.8 mm.

Figure 506.3.7
PREVENTION OF GREASE ACCUMULATION

the need for maintenance, and maintenance allows continued operation. Because grease can and will liquefy on a duct wall, cleanouts are required in any portion of a grease duct system that cannot be reached for cleaning and inspection from the duct entry or discharge. Cleanout doors must be constructed to comply with Section 506.3.1.1, and must be tight fitting and operable without the use of tools. Although cleanout doors must be readily openable to allow inspection by fire and maintenance personnel and to encourage frequent maintenance inspections and cleaning, it is not clear why the use of basic tools (e.g., a screwdriver or a pair of pliers) is prohibited. Latching devices must be provided to hold cleanout doors reasonably air tight when closed. Air leakage at cleanout openings would reduce exhaust system effectiveness and, in positive-pressure ducts, would allow exhaust leakage to the exterior of the duct. Because ducts are designed to contain a grease fire, cleanout openings must not reduce duct integrity (see Figure 506.3.8).

506.3.8.1 Personnel entry. Where ductwork is large enough to allow entry of personnel, not less than one approved or listed opening having dimensions not less than 20 inches by 20 inches (508 mm by 508 mm) shall be provided in the horizontal sections, and in the top of vertical risers. Where such entry is provided, the duct and its supports shall be capable of supporting the additional load and the cleanouts specified in Section 506.3.8 are not required.

❖ Large grease ducts could be designed to allow maintenance personnel to enter the duct for cleaning. This could make the cleanouts specified in Section 506.3.9 unnecessary. Where such access is intended, the access doors must be of adequate size to allow personnel to easily enter the duct. The duct must also be capable of supporting the additional weight of personnel and the dynamic loading caused by movement of personnel.

506.3.9 Grease duct horizontal cleanouts. Cleanouts located on horizontal sections of ducts shall be spaced not more than 20 feet (6096 mm) apart. The cleanouts shall be located on the side of the duct with the opening not less than 1.5 inches (38 mm) above the bottom of the duct, and not less than 1 inch (25 mm) below the top of the duct. The opening minimum dimensions shall be 12 inches (305 mm) on each side. Where the dimensions of the side of the duct prohibit the cleanout installation prescribed herein, the openings shall be on the top of the duct or the bottom of the duct. Where located on the top of the duct, the opening edges shall be a minimum of 1 inch (25 mm) from the edges of the duct. Where located in the bottom of the duct, cleanout openings shall be designed to provide internal damming around the opening, shall be provided with gasketing to preclude grease leakage, shall provide for drainage of grease down the duct around the dam, and shall be approved for the application. Where the dimensions of the sides, top or bottom of the duct preclude the installation of the prescribed minimum-size cleanout opening, the cleanout shall be located on the duct face that affords the largest opening dimension and shall be installed with the opening edges at the prescribed distances from the duct edges as previously set forth in this section.

❖ The 20-foot (6096 mm) interval requirement ensures that not more than 10 feet (3048 mm) of duct will extend beyond the access provided by any cleanout. Thus, cleanouts should not be located farther than 10 feet (3048 mm) from any change of direction in the duct. Cleanout openings should be located only on the vertical sides of a horizontal run to prevent the leakage of grease. Cleanout openings in duct sidewalls should not extend to the bottom of the duct because this would allow grease to leak from the duct. At least 1 inch (25 mm) of the duct sidewall should remain below the bottom edge of the cleanout to prevent grease from running out of the duct. Cleanouts are allowed in the top and bottom of horizontal ducts only where it is not possible to put the required size cleanout in the vertical sidewalls.

Additional cleanouts should be installed in any portion of a duct system that cannot be reached for cleaning and inspection from the required cleanouts. The cleanout openings must have a minimum dimension of 12 inches (305 mm) to permit access for cleaning of the system. If the side of the duct is not large enough to permit the required cleanout size, the cleanout must be relocated to the top of the duct, or as a last resort, the bottom of the duct. Cleanouts located on the bottom of a duct would promote leakage of grease; therefore, internal barriers (dams) must be installed around the full perimeter of the opening. These barriers/dams must not prevent grease from draining to the intended collection point. If the largest dimension of a duct is less than that necessary to accommodate the required size cleanout, the cleanout would have to be as large as the duct dimensions would permit, on the duct face allowing the largest opening and would have to meet the opening edge requirements of this section.

506.3.10 Grease duct enclosure. A grease duct serving a Type I hood that penetrates a ceiling, wall or floor shall be enclosed from the point of penetration to the outlet terminal. A duct shall penetrate exterior walls only at locations where unprotected openings are permitted by the *International Building Code*. Ducts shall be enclosed in accordance with the *International Building Code* requirements for shaft construction. The duct enclosure shall be sealed around the duct at the point of penetration and vented to the outside of the building through the use of weather-protected openings. Clearance from the duct to the interior surface of enclosures of combustible construction shall be not less than 18 inches (457 mm). 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). The duct enclosure shall serve a single grease exhaust duct system and shall not contain any other ducts, piping, wiring or systems.

Exceptions:

1. The shaft enclosure provisions of this section shall not be required where a duct penetration is protected with a through-penetration firestop system classified in accordance with ASTM E 814 and having an "F" and

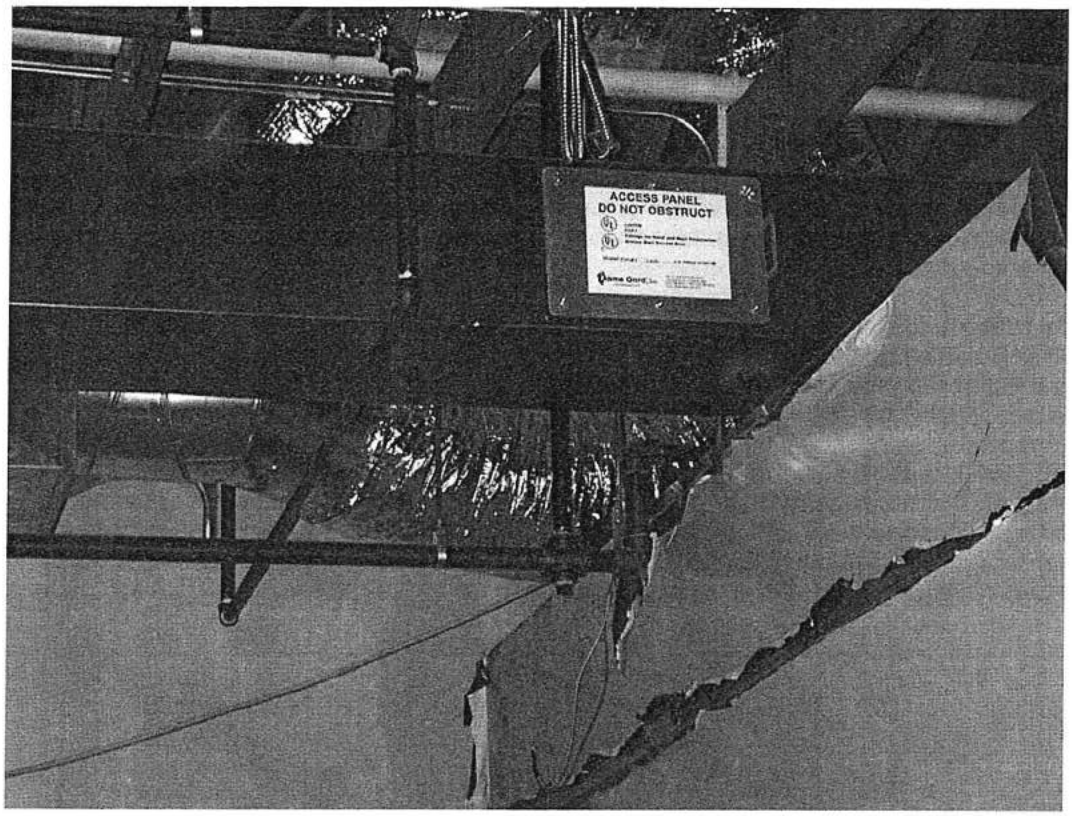


Figure 506.3.8
GREASE DUCT CLEANOUT

"T" rating equal to the fire-resistance rating of the assembly being penetrated and where the surface of the duct is continuously covered on all sides from the point at which the duct penetrates a ceiling, wall or floor to the outlet terminal with a classified and labeled material, system, method of construction or product specifically evaluated for such purpose, in accordance with ASTM E 2336. Exposed ductwrap systems shall be protected where subject to physical damage.

2. The shaft enclosure provisions of this section shall not be required where a duct penetration is protected with a through-penetration firestop system classified in accordance with ASTM E 814 and having an "F" and "T" rating equal to the fire resistance rating of the assembly being penetrated and where a prefabricated grease duct enclosure assembly is protected on all sides from the point at 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.

3. A duct enclosure shall not be required for a grease duct that penetrates only a nonfire-resistance-rated roof/ceiling assembly.

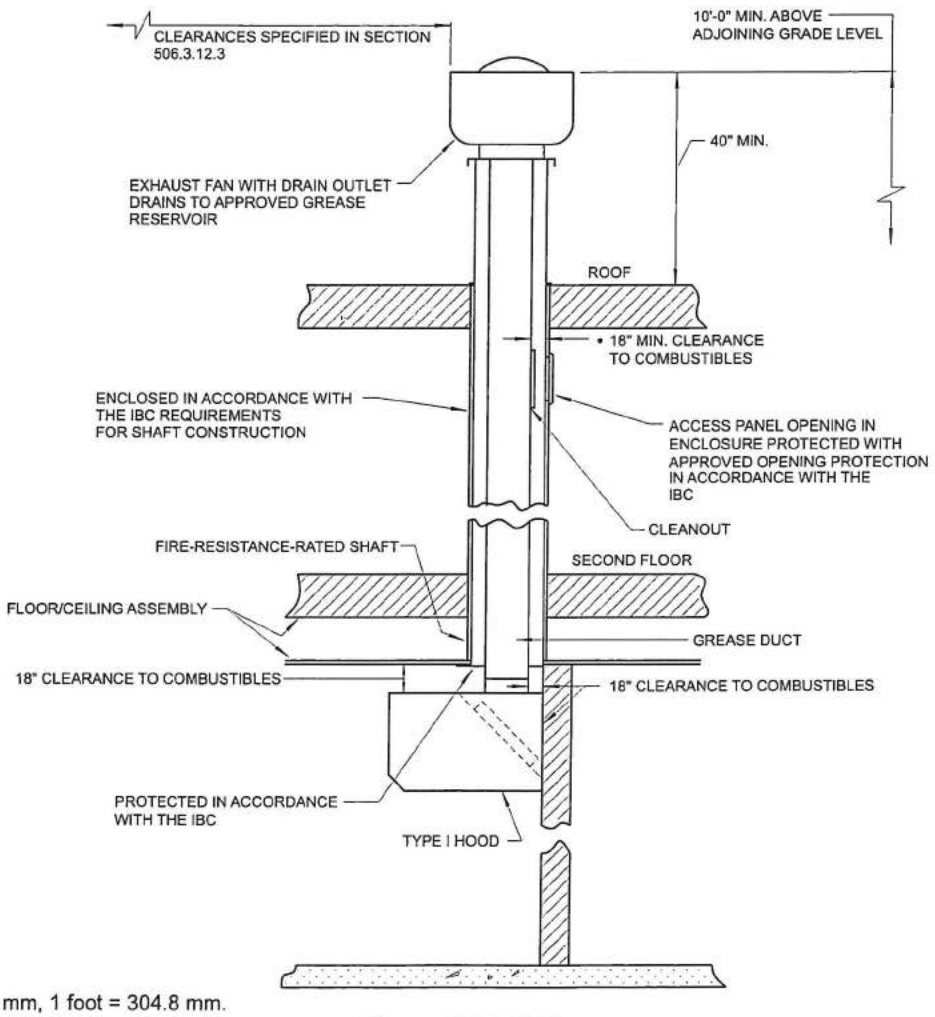
❖ A shaft enclosure is required where a grease duct serving a Type I hood penetrates a wall, floor or ceiling whether or not the walls, floors or ceilings are fire-resistance rated, except as exempted by Exception 3, which allows penetration of an unrated roof/ceiling assembly without a shaft enclosure. This could allow penetration of a drop-in ceiling in a one-story building by a grease duct without a shaft enclosure. The shaft enclosure maintains the integrity of the assembly it is penetrating, and reduces the possibility of smoke and fire in the kitchen spreading to other parts of the building. The required enclosure also protects the duct from physical damage and prevents the exhaust duct from coming into contact with combustible materials.

Although the term "shaft" is associated with a vertical passageway, the shaft enclosure required by this section must enclose both vertical and horizontal sections of the grease exhaust duct system. The shaft enclosure must begin at the first point of penetration and must be continuous to the duct termination. In other words, the shaft must originate in the room or space containing the hood and must extend to the duct discharge outdoors. In the case where an inline grease fan is installed in the grease duct, in other than the room of origin, the inline fan would have to be enclosed within the shaft enclosure.

Figure 506.3.10(1) illustrates an exhaust duct enclosed by a vertical shaft. The enclosure must be constructed to comply with the IBC, including the bottom or origin of the shaft enclosure. The reference to the IBC for shaft construction means that the IBC regulates the fire-resistance rating and construction of the assemblies that form the duct enclosure (shaft), whereas this code determines when and where an enclosure is required. A grease duct that runs horizontally through walls to the exterior would be required by the code to be in a 1-hour fire-resistance-rated shaft even though the IBC only requires a fire-resistance-rated shaft when penetrating floor/ceiling assemblies and connecting multiple stories. Panels or doors in the enclosure providing access to cleanouts must be approved opening protectives that comply with the IBC.

Figure 506.3.10(2) illustrates an exhaust duct penetrating a wall and extending through an adjacent room before exiting the building. All segments of the duct beyond the wall penetration are protected by the enclosure. The duct termination at the exterior of the building must be protected against damage caused by precipitation, wind or other weather conditions.

The minimum clearance dimensions are required around the grease duct to protect combustibles, allow for some convection cooling and allow for uniform inspection of the outside surface of the duct. In the event that a fire has occurred in the system, the duct system must be inspected to determine whether it has been damaged or is otherwise unfit for continued service. Clearance to combustibles for ducts not enclosed in a shaft is addressed in Section 506.3.6. The 6-inch (152 mm) minimum clearance is required to allow visual inspection of the duct, especially after a fire event. The shaft is intended to isolate the grease duct from all other ducts, including other grease ducts. In other words, if there are two separate Type I kitchen hoods in the same kitchen with separate grease ducts that are routed to separate exhaust fans on the roof, the grease ducts are not permitted to be located in the same fire-resistance-rated shaft. It is important to note



For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

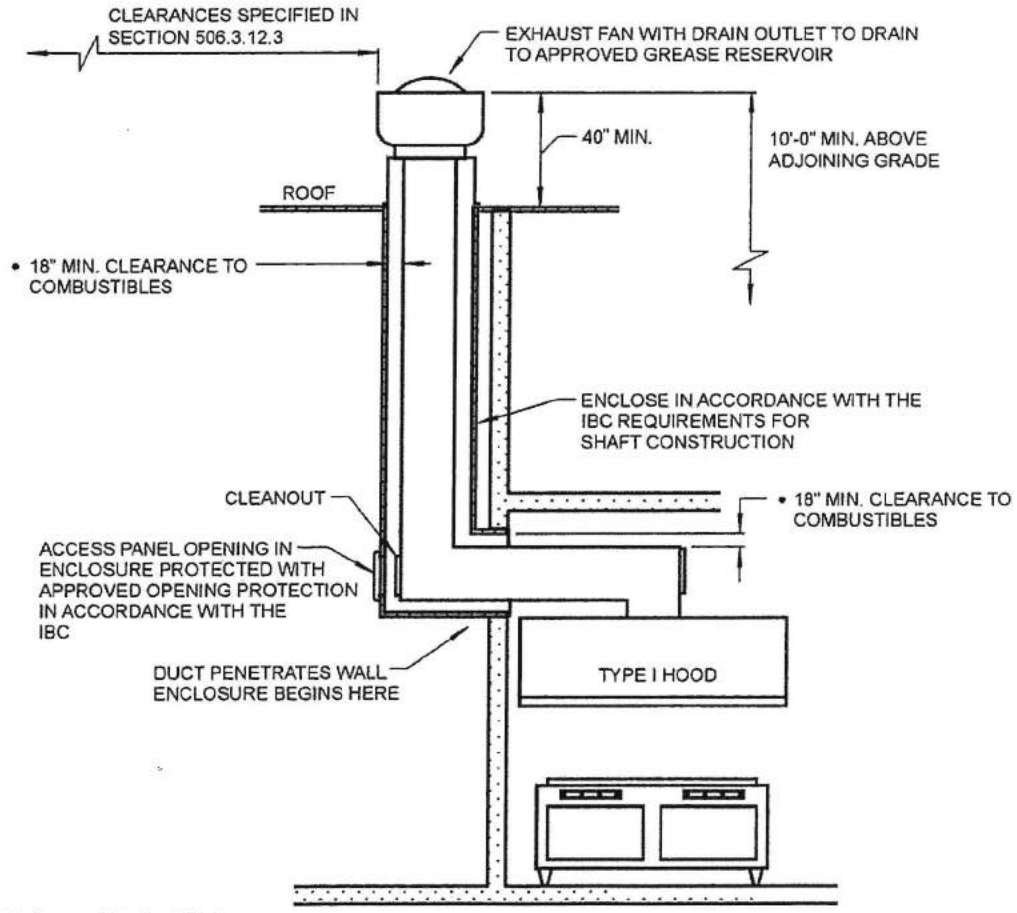
Figure 506.3.10(1)
EXHAUST DUCT ENCLOSED BY A VERTICAL SHAFT

that when using a grease duct wrap system as an alternative to a shaft enclosure as allowed by Exception 1, the 6-inch (152 mm) clearance is not required; however, in the event of a fire in the grease duct, the duct wrap might have to be removed in order to inspect the condition of the duct.

If the duct enclosure (shaft) construction is combustible, grease ducts must maintain a minimum clearance to combustibles of 18 inches (457 mm). Typical construction for shafts is gypsum board on metal studs and this kind of assembly is treated as noncombustible under the provisions of this section. An assembly of gypsum board on wood studs is treated as a combustible assembly and the 18-inch (457 mm) clearance would apply.

Exceptions 1 and 2 offer two alternatives to a shaft enclosure: either a duct covering/enclosure system [see Figure 506.3.10(3)] or a prefabricated grease duct enclosure system, respectively. Both exceptions require the system to be tested as an approved through-penetration firestop system. An approved through-penetration firestop system is one that has been tested in accordance with ASTM E 814. The test method determines the performance of the protection system when exposed to a standard time-temperature fire test and hose-stream test. The performance of the protection system is dependent on the specific assembly of materials tested, including the number, type and size of penetrations and the type of floor, wall or ceiling in which it is installed. It should also be noted that tests have been conducted at various pressure differentials; however, the current criterion used is 0.01 inch (0.025 kPa) of water gauge, and only tests with this minimum pressure throughout the test period are to be accepted.

In evaluating test reports, the code official must determine that the tested assembly is truly representative of the proposed system installation. The ASTM E 814 test establishes two ratings. These are the F rating, which identifies the ability of the material to resist the passage of flame, and the T rating, which identifies the thermal transmission characteristics of the



For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

Figure 506.3.10(2)
EXHAUST DUCT PENETRATING A WALL

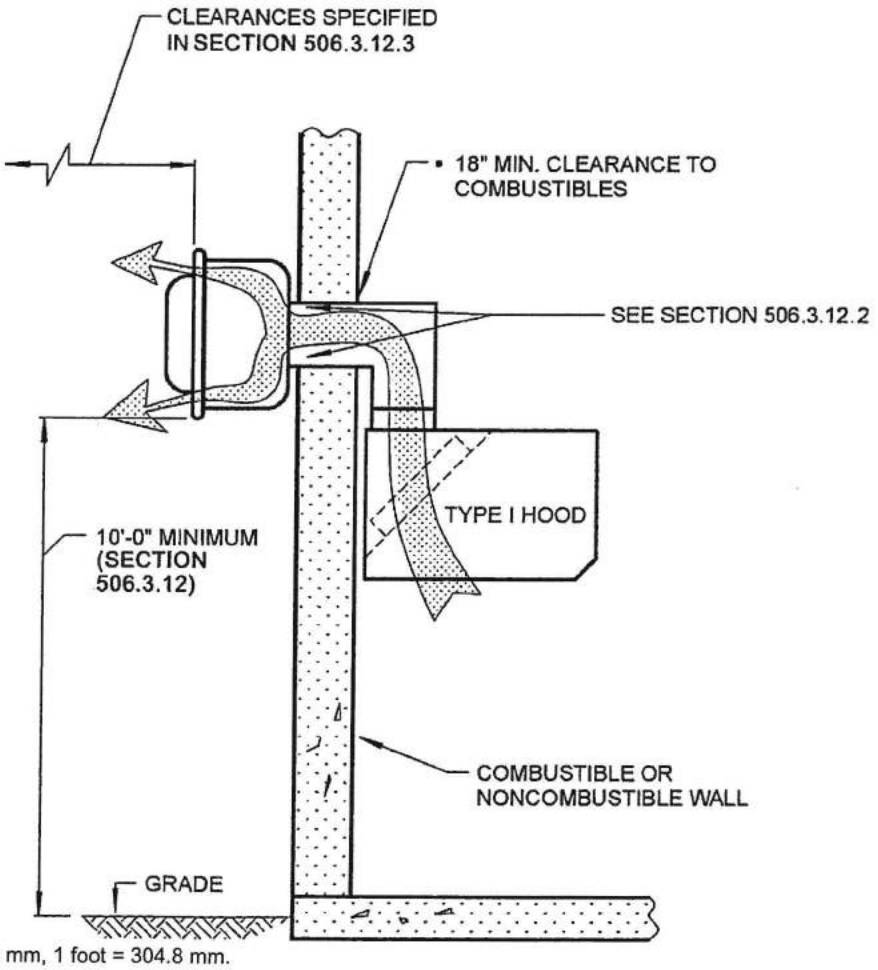
material or assembly.

In addition to being tested as a through-penetration firestop system in accordance with ASTM E 814, Exception 1 requires the duct covering/enclosure system to be evaluated for the intended purpose in accordance with ASTM E 2336, *Fire Resistive Grease Duct Enclosure Systems*. Such systems include what is commonly referred to as "grease duct fire wrap." The duct covering/enclosure system is evaluated by testing for the following: noncombustibility, fire endurance, durability, internal fire and fire engulfment with a through-penetration firestop. Exposed duct wrap systems must be protected where subject to physical damage.

Exception 2 is another alternative to a shaft where a prefabricated system, such as a factory-built grease duct, is tested as a through-penetration firestop system in accordance with ASTM E 814, as well as being evaluated in accordance with UL 2221, *Standard for Tests of Fire Resistive Grease Duct-Enclosure Assemblies*. The prefabricated grease duct enclosure system is evaluated by testing that is very similar to the testing for the grease duct fire wrap: noncombustibility, internal and external fire tests, external fire test with fire engulfment and external fire test with a firestop test.

Note that in addition to being evaluated as an alternative to a shaft, duct wraps and the factory-built grease ducts also offer reduced clearance to combustibles, with some offering zero clearance to combustibles. The actual clearance to combustibles will be indicated on the label for the particular product and the installation must be in accordance with the manufacturer's installation instructions. The reduced clearances that these products offer make them a possible solution to clearance problems that may be encountered when, for example, a grease duct is routed up through a roof of a building of wood-frame construction (see Figure 506.3.6).

Exception 3 allows omitting duct enclosures where they would have little value. The typical single-story restaurant of Type V unprotected construction will have grease ducts penetrating only nonrated roof/ceiling assemblies. Grease ducts in such buildings do not pass through stories and are inherently protected by their inaccessible location in the attic spaces.



For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

Figure 506.3.10(3)
TERMINATION THROUGH EXTERIOR WALL

506.3.11 Grease duct fire-resistive access opening. Where cleanout openings are located in ducts within a fire-resistance-rated enclosure, access openings shall be provided in the enclosure at each cleanout point. Access openings shall be equipped with tight-fitting sliding or hinged doors that are equal in fire-resistive protection to that of the shaft or enclosure. An approved sign shall be placed on access opening panels with wording as follows: "ACCESS PANEL. DO NOT OBSTRUCT."

❖ The requirements of this section relate to the requirements of Sections 506.3.8 and 506.3.10. The construction of the shaft enclosure, including opening protectives, must meet IBC requirements. Where a cleanout occurs in a grease duct system that is enclosed as required by Section 506.3.10, an opening must be placed in the enclosure to provide access to the cleanout. To maintain shaft integrity, these opening protectives must afford the same fire protection as that of the shaft enclosure.

506.3.12 Exhaust outlets serving Type I hoods. Exhaust outlets for grease ducts serving Type I hoods shall conform to the requirements of Sections 506.3.12.1 through 506.3.12.3.

❖ This section regulates the termination of grease ducts that serve Type I hoods. While Section 506.5.5 references the user back to this section for the termination for exhaust equipment (i.e., exhaust fans), this section is only referring to outlets serving a Type I hood. An example of this would be where an inline grease fan is installed and only the grease duct outlet extends to the exterior of the building.

506.3.12.1 Termination above the roof. Exhaust outlets that terminate above the roof shall have the discharge opening located not less than 40 inches (1016 mm) above the roof surface.

❖ The requirement for the discharge opening to be at least 40 inches (1016 mm) above the roof surface is intended to prevent the accumulation of grease residue on surrounding surfaces and to allow the diffusion of the exhaust into the surrounding air currents. The intent is that the discharge be directed away from the roof.

This section addresses only grease duct exhaust outlets serving Type I hoods. Exhaust outlets for Type II hoods must comply with Sections 401.4, 401.4.2 and 501.2.1 (see Section 506.4.1).

506.3.12.2 Termination through an exterior wall. Exhaust outlets shall be permitted to terminate through exterior walls where the smoke, grease, gases, vapors, and odors in the discharge from such terminations do not create a public nuisance or a fire hazard. Such terminations shall not be located where protected openings are required by the *International Building Code*. Other exterior openings shall not be located within 3 feet (914 mm) of such terminations.

❖ Exhaust outlets can terminate through a wall only if a fire hazard or public nuisance is not created. Because of the many different places the exhaust can terminate and the various types of discharge, exterior wall terminations must be evaluated on a case-by-case basis by the code official. In some locations, a wall termination could create a public nuisance because of odors, smoke, grease discharge and the proximity of other buildings, walkways and other occupied areas. Terminations through the exterior wall must be located so that they do not create a fire hazard. For example, a termination through the exterior wall below a roof soffit should be avoided due to the possibility of grease collecting on the soffit.

Section 506.3.10 allows ducts to penetrate exterior walls only where unprotected openings are allowed by the IBC (see commentary, Section 501.2). This section requires the same by prohibiting wall terminations in walls required to have protected openings. Depending on the building's proximity to lot lines and other buildings, the building code might require that openings in exterior walls be protected with fire-resistance-rated opening protectives. The wall termination must be located at least 3 feet (914 mm) from all openings, including any window (fixed or openable), door, air exhaust or intake opening.

This section addresses only grease duct exhaust outlets serving Type I hoods. Exhaust outlets for Type II hoods must comply with Sections 401.4, 401.4.2 and 501.2.1 (see Section 506.4.1).

506.3.12.3 Termination location. Exhaust outlets shall be located not less than 10 feet (3048 mm) horizontally from parts of the same or contiguous buildings, adjacent buildings, adjacent property lines and air intake openings into any building and shall be located not less than 10 feet (3048 mm) above the adjoining grade level.

Exception: Exhaust outlets shall terminate not less than 5 feet (1524 mm) from parts of the same or contiguous building, an adjacent building, adjacent property line and air intake openings into a building where air from the exhaust outlet discharges away from such locations.

❖ This section addresses only grease duct exhaust outlets serving Type I hoods. Exhaust outlets for Type II hoods must comply with Sections 401.4, 401.4.2 and 501.2.1 (see Section 506.4.1).

The discharge of the exhaust system must be located to minimize accumulation of grease on parts of the same, contiguous or adjacent buildings and to prevent the entry of exhaust discharge into any fresh air intake or other opening to any building. The exhaust outlet must be located a minimum distance above grade to protect passersby and to help the dispersion of the exhaust into the atmosphere.

The exception allows reduced horizontal clearance where the exhaust discharge is directed so as not to affect adjacent property or enter any building. Although not stated, it is logical to apply this exception to parts of the same building on which the exhaust outlet is located. The intent of the exception is to grant relief from the 10-foot (3048 mm) clearance requirement where the exhaust is directed away from what the code is trying to protect.

506.4 Ducts serving Type II hoods. Single or combined Type II exhaust systems for food-processing operations shall be independent of all other exhaust systems. Commercial kitchen exhaust systems serving Type II hoods shall comply with Sections 506.4.1 and 506.4.2.

❖ This section addresses ducts serving only Type II hoods. Although grease is not involved, there is the potential for fire and smoke to spread from the kitchen to other parts of the building; therefore, exhaust ducts serving Type II exhaust systems are prohibited from interconnecting with any other exhaust ducts other than Type II exhaust ducts.

506.4.1 Type II exhaust outlets. Exhaust outlets for ducts serving Type II hoods shall comply with Sections 401.4 and 401.4.2. Such outlets shall be protected against local weather conditions and shall meet the provisions for exterior wall opening protectives in accordance with the *International Building Code*.

❖ Because grease is not involved, the termination requirements for Type II exhaust systems are not nearly as stringent as those for Type I exhaust systems; however, there are many similarities. Sections 401.4 and 401.4.2 intend to prevent exhaust terminals from being a nuisance to neighbors and to the public in general. Type II exhaust outlets must be a minimum of 10 feet (3048 mm) from lot lines and buildings on the same lot in accordance with Section 401.4. While Type II exhaust outlets do not have any specific requirements for distance, they must be located away from an intake opening; intake openings are regulated by Section 401.4.1 of the code. Unlike Type I systems, a Type II exhaust may terminate through an exterior wall that is required by the IBC to have protected openings. In such cases, the duct termination opening would have to be protected by a closure device such as a fire damper.

506.4.2 Ducts. Ducts and plenums serving Type II hoods shall be constructed of rigid metallic materials. Duct construction, installation, bracing and supports shall comply with Chapter 6. Ducts subject to positive pressure and ducts conveying moisture-laden or waste-heat-laden air shall be constructed, joined and sealed in an approved manner.

❖ Nongrease ducts and plenums serving Type II hoods are not subjected to the same hazards as grease ducts serving Type I hoods. Because nongrease duct systems control the waste heat and vapors associated with Type II hoods, they must be constructed of rigid metallic materials, and be braced and supported to comply with Section 603. SMACNA *HVAC Duct Construction Standards—Metal and Flexible* contains information on duct sealing. For positive duct pressure applications, duct joints must be sealed, including longitudinal joints, transverse joints and connections. Ducts must be sealed with approved materials (such as mastic with fibrous backing tape or pressure-sensitive tape) consistent with Chapter 6. Type II hood ducts could be subjected to wetting from condensation and, therefore, must be constructed with this in mind.

506.5 Exhaust equipment. Exhaust equipment, including fans and grease reservoirs, shall comply with Sections 506.5.1 through 506.5.5 and shall be of an approved design or shall be listed for the application.

❖ Exhaust fans, motors, grease reservoirs and other related equipment can be subjected to high temperatures and severe duty; therefore, they must be tested and listed for the intended application or specifically approved.

506.5.1 Exhaust fans. Exhaust fan housings serving a Type I hood shall be constructed as required for grease ducts in accordance with Section 506.3.1.1.

Exception: Fans listed and labeled in accordance with UL 762.

❖ Commercial kitchen exhaust fan housings serving Type I hoods must be constructed of steel and must be capable of handling hot grease-laden air and smoke (see the definition of "Hood, Type I"). The fan must also be designed to collect grease and divert it to a point of collection to prevent a fire hazard and damage to the building surfaces. Fan housings constructed of steel have the integrity to withstand the operating temperatures and conditions related to a duct system fire. There are two types of exhaust fans that serve Type I hoods; the traditional exterior-mounted exhaust fan (i.e., either through the roof or exterior wall) and interior-mounted inline fans [see Figures 506.5.1(1) and 506.5.1(2)].

The exception recognizes other fan housing materials such as aluminum alloys. Fans of materials other than steel must be specifically listed for commercial kitchen applications.

506.5.1.1 Fan motor. Exhaust fan motors shall be located outside of the exhaust airstream.

❖ An exhaust fan motor cannot be installed in locations that expose it to the exhaust airflow. Exposure to high temperatures and grease-laden vapors will shorten the life of the motor, and a malfunctioning motor can be a potential ignition source. The exhaust fan would be better located at or as close as possible to the discharge end of the duct to minimize exposure temperatures and the amount of the duct system that is exposed to positive pressures. Typical commercial kitchen exhaust fan designs, both direct drive and belt driven, place motors in shielded locations not subject to the exhaust flow.

506.5.2 Exhaust fan discharge. Exhaust fans shall be positioned so that the discharge will not impinge on the roof, other equipment or appliances or parts of the structure. A vertical discharge fan shall be manufactured with an approved drain outlet at the lowest point of the housing to permit drainage of grease to an approved grease reservoir.

❖ Exhaust must be discharged away from the roof, other equipment and other parts of the structure to eliminate damage or a fire hazard caused by the high-temperature discharge and condensable grease-laden vapor. Vertical discharge (upblast) fans must have an integral

grease drainage path leading to an approved grease collection container. Figure 506.5.1(1) illustrates a grease drain to a reservoir.

506.5.3 Exhaust fan mounting. An upblast fan shall be hinged and supplied with a flexible weatherproof electrical cable to permit inspection and cleaning. The ductwork shall extend a minimum of 18 inches (457 mm) above the roof surface.

❖ Scheduled inspections and maintenance of upblast exhaust fans are not easily performed if a fan has to be lifted off of its roof curb. A hinged base simplifies inspection and maintenance. The flexible electrical cable provides freedom of movement when opening the hinged fan body without damaging the electrical connection. The 18-inch (457 mm) duct extension is required by NFPA 96. Figure 506.5.1(1) illustrates a hinged upblast fan with a flexible electrical connection and a grease drain that will pull out of the grease reservoir when the fan is tilted.

506.5.4 Clearances. Exhaust equipment serving a Type I hood shall have a clearance to combustible construction of not less than 18 inches (457 mm).

Exception: Factory-built exhaust equipment installed in accordance with Section 304.1 and listed for a lesser clearance.

❖ Exhaust equipment is subject to the same exposure to grease fires as the ducts themselves. Therefore, the clearance requirements are the same as those in Section 506.3.6 (see commentary, Section 506.3.6).

506.5.5 Termination location. The outlet of exhaust equipment serving Type I hoods shall be in accordance with Section 506.3.12.

Exception: The minimum horizontal distance between vertical discharge fans and parapet-type building structures shall be 2 feet (610 mm) provided that such structures are not higher than the top of the fan discharge opening.

❖ Exhaust equipment must terminate in the same manner as specified for Type I duct systems in Section 506.3.12 (see commentary, Section 506.3.12). Note that Section 506.3.12 is for grease duct outlets and that exhaust equipment must terminate in accordance with Section 506.3.12 but also at a point where there is access for servicing the equipment.

The exception allows reduced horizontal clearance between vertical discharge fans and parapet walls where the fan discharge opening is as high as or higher than the parapet wall (see Figure 506.5.5).

SECTION 507
COMMERCIAL KITCHEN HOODS

507.1 General. Commercial kitchen exhaust hoods shall comply with the requirements of this section. Hoods shall be Type I or Type II and shall be designed to capture and confine cooking vapors and residues. Commercial kitchen exhaust hood systems shall operate during the cooking operation.

Exceptions:

1. Factory-built commercial exhaust hoods which are tested in accordance with UL 710, listed, labeled and installed in accordance with Section 304.1 shall not be required to comply with Sections 507.4, 507.7, 507.11, 507.12, 507.13, 507.14 and 507.15.
2. Factory-built commercial cooking recirculating systems which are tested in accordance with UL 710B, listed, labeled and installed in accordance with Section 304.1 shall not be required to comply with Sections 507.4, 507.5, 507.7, 507.12, 507.13, 507.14 and 507.15.
3. Net exhaust volumes for hoods shall be permitted to be reduced during no-load cooking conditions, where engineered or listed multispeed or variable-speed controls automatically operate the exhaust system to maintain capture and removal of cooking effluents as required by this section.

❖ Type I and II commercial kitchen exhaust hoods must be listed and labeled by an approved agency or must be constructed to conform to the requirements of this chapter. Type I kitchen hoods must be installed above all cooking appliances that produce grease-laden vapors. Type II kitchen hoods must be installed above cooking or dishwashing appliances that produce heat, steam and/or products of combustion. Note that the code states that cooking appliances must never operate without the commercial kitchen exhaust hood system also being in operation. Exception 1 to this section states the requirements for factory-built commercial exhaust hoods and specifies which code provisions are not applicable to factory-built hoods. Shop-built and field-constructed hoods are subject to all of the design and fabrication requirements of Section 507.

A factory-built commercial exhaust hood that has been tested in accordance with UL 710 and listed and labeled by an approved agency must be installed in accordance with the manufacturer's instructions [see Figure 507.1(1)]. The importance of installing the system in strict compliance with the manufacturer's instructions cannot be over emphasized. These instructions contain specific installation requirements that are critical to the proper and efficient operation of the hood.

This section states that listed and labeled hoods have demonstrated compliance with the construction and design requirements of this section and others, such as Sections 507.4, 507.7, 507.11, 507.12, 507.13, 507.14 and 507.15. The following is a list of some of the information that must be contained within the manufacturer's installation instructions or on the label:

- Minimum and maximum spacing between the front lower edge of the hood and the cooking surface;
- Minimum exhaust airflow quantity;

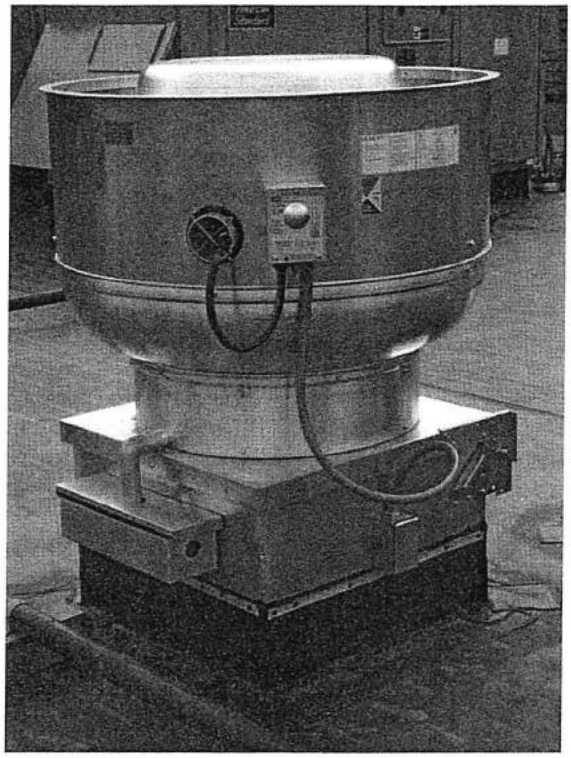


Figure 506.5.1(1)
ROOF-MOUNTED EXHAUST FAN FOR A TYPE I HOOD

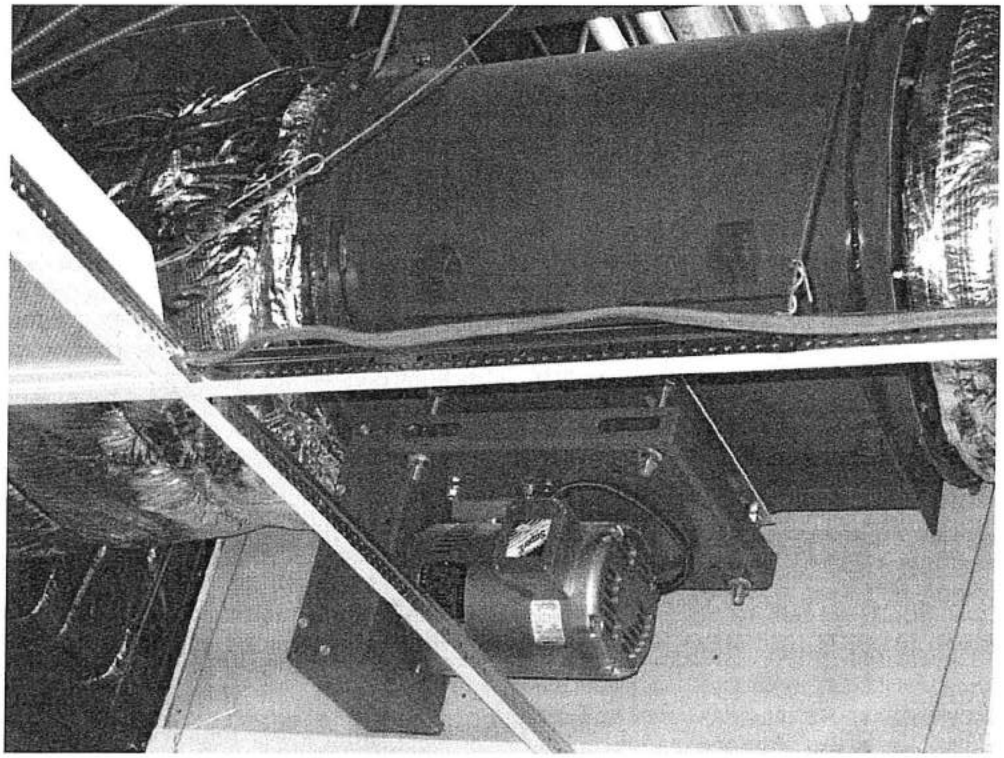
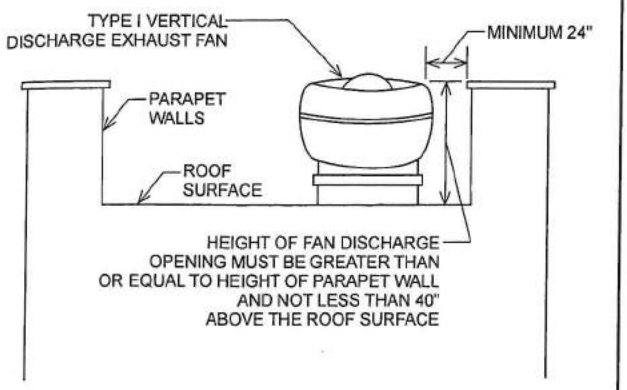


Figure 506.5.1(2)
INLINE EXHAUST FAN FOR A TYPE I HOOD



For SI: 1 inch = 25.4 mm.

Figure 506.5.5
EXHAUST OUTLET TERMINATION

- Maximum supply airflow if the supply air is directed into hood;
- Minimum overhangs of the exhaust hood over the cooking surface;
- Maximum allowable surface temperature of the cooking appliance;
- The specific type of cooking appliance an exhaust hood is intended to serve; and
- Minimum clearance to combustible materials.

It is also important to determine that all parts and subassemblies of an exhaust hood are a component of the tested and labeled exhaust hood, or that the parts and subassemblies have been evaluated under the same conditions of fire severity as the exhaust hood. Furthermore, the exhaust hood must be compatible with and intended for the type of cooking appliance it will serve. Typically, the label of a factory-built hood tested in accordance with UL 710 will indicate the maximum temperature of cooking appliances that can be located under the hood.

It is not the intent of this section to require labeling of exhaust hoods. Unlabeled factory-built hoods and shop/field-constructed hoods are permitted.

A factory-built or field-constructed commercial exhaust hood that has not been tested and labeled in accordance with UL 710 is permitted if it is designed, constructed and installed in accordance with Section 507 and all other applicable requirements of this chapter. This section addresses hood material requirements, hood construction, hood dimensions, exhaust quantities and makeup air requirements. Kitchen exhaust systems must discharge all effluent to the outdoors to comply with Sections 501.2, 506.3.12 and 506.4.

Exception 2 allows installation of factory-built commercial cooking recirculating systems if they have been tested and listed in accordance with UL 710B. Note that the previous edition of the code referenced UL 197, which has now been incorporated into this new standard for recirculating systems, UL 710B. It is important that recirculating systems be installed in accordance with the manufacturer's installation instructions so that the listing requirements are met. An improper installation could result in hazardous vapors being discharged back into the kitchen.

Commercial cooking recirculating systems consist of an electric cooking appliance and an integral or matched packaged hood assembly [see Figures 507.1(2) and 507.1(3)]. The hood assembly consists of a fan, collection hood, grease filter, fire damper, fire-extinguishing system and air filter such as an electrostatic precipitator. These systems are tested for fire safety and emissions. The grease vapor (condensible particulate matter) in the effluent at the system discharge is not allowed to exceed a concentration of 5.0 mg/m^3. Recirculating systems are not used with fuel-fired appliances because the filtering systems do not remove combustion products. Note that kitchens require ventilation in accordance with Chapter 4.

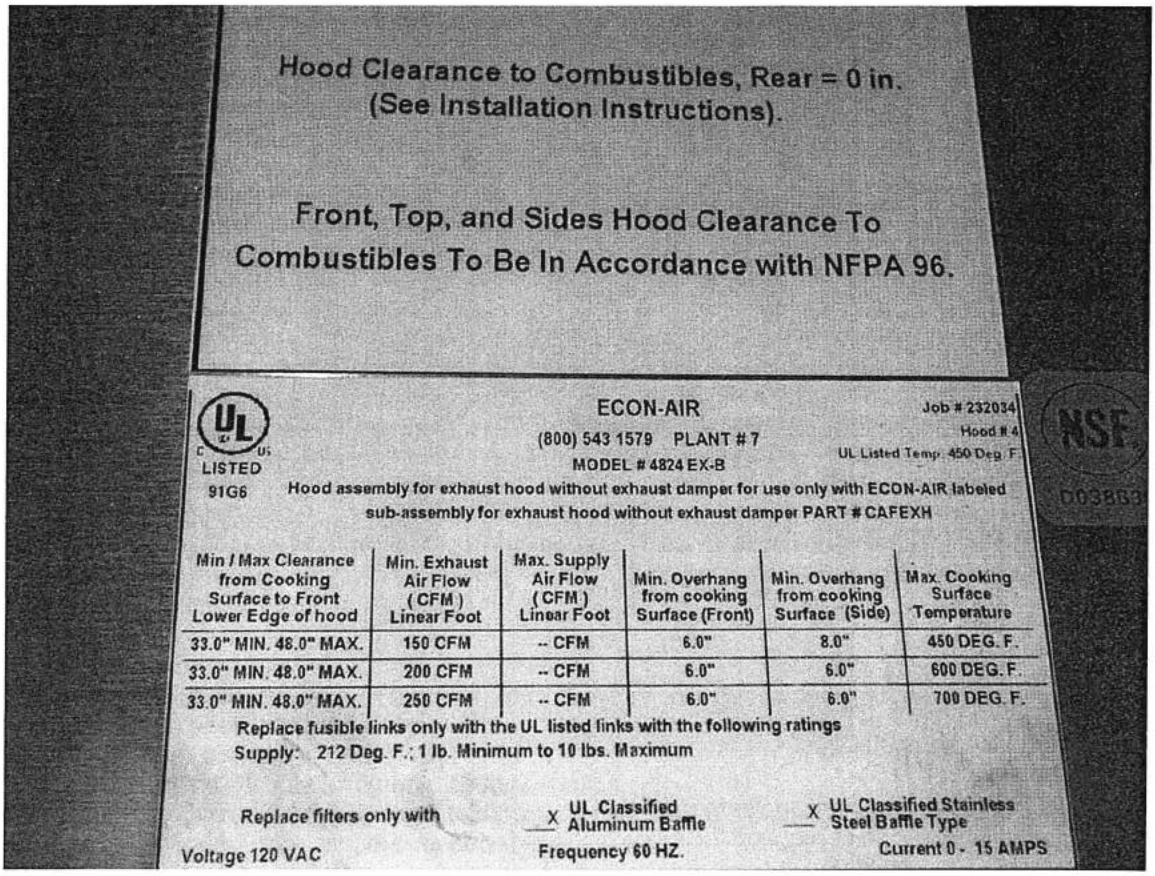
Exception 3 allows reduction of the exhaust rate of commercial hoods when no cooking is taking place. Net exhaust volumes are based on the assumption that full-load cooking is taking place. In fact, no load or part-load cooking conditions represent the majority of time for most food service operations. Although the hoods should obviously be designed for maximum load, this should not prevent operating the hoods at a reduced exhaust rate when the actual load is less than maximum if the intent of the code is still satisfied (i.e., capture and removal of cooking effluents). Reducing the exhaust rates during reduced use can help to improve system performance (fire safety, occupant health, energy efficiency and kitchen comfort).

The majority of gas-fired cooking appliance installations use the exhaust hood as a means of venting the combustion byproducts of the cooking appliances. Commercial cooking appliances are either connected to a vent or chimney or the flue outlet discharges into the exhaust hood. The exhaust hood system must be operating when appliances that depend on the exhaust system to vent combustion byproducts are in use. Gas-fired appliances must be interlocked with the hood system if combustion gases are vented by that system (see Section 505.1.1 of the IFGC).

All hoods, listed and unlisted, must capture and confine cooking vapors within the hood to prevent spillage into the room (see commentary, Section 507.16).

507.2 Where required. A Type I or Type II hood shall be installed at or above all commercial cooking appliances in accordance with Sections 507.2.1 and 507.2.2. Where any cooking appliance under a single hood requires a Type I hood, a Type I hood shall be installed. Where a Type II hood is required, a Type I or Type II hood shall be installed.

❖ An exhaust system is required for "Commercial cooking appliances," as defined in Chapter 2. In addition to the specific cooking appliances identified in the defini-



Hood Clearance to Combustibles, Rear = 0 in.
(See Installation Instructions).

Front, Top, and Sides Hood Clearance To Combustibles To Be In Accordance with NFPA 96.

ECON-AIR
(800) 543 1579 PLANT # 7
MODEL # 4824 EX-B
Job # 232034
Hood # 4
UL Listed Temp. 450 Deg. F.
LISTED 91G6
Hood assembly for exhaust hood without exhaust damper for use only with ECON-AIR labeled sub-assembly for exhaust hood without exhaust damper PART # CAFEXH

Min / Max Clearance from Cooking Surface to Front Lower Edge of hood	Min. Exhaust Air Flow (CFM) Linear Foot	Max. Supply Air Flow (CFM) Linear Foot	Min. Overhang from cooking Surface (Front)	Min. Overhang from cooking Surface (Side)	Max. Cooking Surface Temperature
33.0" MIN. 48.0" MAX.	150 CFM	-- CFM	6.0"	8.0"	450 DEG. F.
33.0" MIN. 48.0" MAX.	200 CFM	-- CFM	6.0"	6.0"	600 DEG. F.
33.0" MIN. 48.0" MAX.	250 CFM	-- CFM	6.0"	6.0"	700 DEG. F.

Replace fusible links only with the UL listed links with the following ratings
Supply: 212 Deg. F.; 1 lb. Minimum to 10 lbs. Maximum

Replace filters only with
X UL Classified Aluminum Baffle
X UL Classified Stainless Steel Baffle Type
Voltage 120 VAC
Frequency 60 HZ.
Current 0 - 15 AMPS

NSF D03883

Figure 507.1(1)
TYPICAL LABEL FOR A TYPE I HOOD

tion, further examples of commercial cooking appliances that require a commercial kitchen exhaust system are: griddles (flat or grooved); tilting skillets or woks; braising and frying pans; roasters; pastry ovens; pizza ovens; charbroilers; salamander and upright broilers; infrared broilers; and open-burner stoves and ranges. Furthermore, the definition of "Commercial cooking appliances" defines a food service establishment as "any building or portion thereof used for the preparation and serving of food." Within the context of Section 507, the "preparation and serving of food" includes operations such as preparing, handling, cleaning, cooking and packaging foodstuffs of any sort. The obvious examples of a food service establishment are restaurants and school cafeterias. A less obvious example is a church with a fellowship hall that holds fund-raising events such as spaghetti dinners, fish fries or pancake breakfasts. Even a child day care facility may be loosely classified as a food service establishment if a hot breakfast or lunch is served to the children as part of their care. For a discussion on where a Type I versus Type II hood is required, see the commentary to Section 507.2.1.

A Type I hood must always be installed above a cooking appliance that produces smoke and grease-laden vapors (see commentary, Section 507.2.1). The last sentence of this section simply states that either a Type I or II hood may be installed above a cooking appliance that requires only a Type II hood.

507.2.1 Type I hoods. Type I hoods shall be installed where cooking appliances produce grease or smoke, such as occurs with griddles, fryers, broilers, ovens, ranges and wok ranges.

❖ This section requires Type I hoods for handling grease-laden vapors and smoke from cooking appliances (see definition of "Hood, Type I"). The term "grease" refers to animal and vegetable fats and oils that are used to cook foods or that are a byproduct of cooking foods. Cooking appliances are used for commercial purposes when the appliance is primarily used for the preparation of food for compensation, trade or services rendered. When the nature of the cooking produces grease-laden vapors in sufficient quantities to constitute a hazard, a Type I hood is required.

Cooking appliances installed in cafeterias, restaurants, dormitory kitchens, hotels, motels, schools and institutional occupancies are examples of appliances that typically require Type I exhaust hood systems. Some examples of commercial cooking appliances

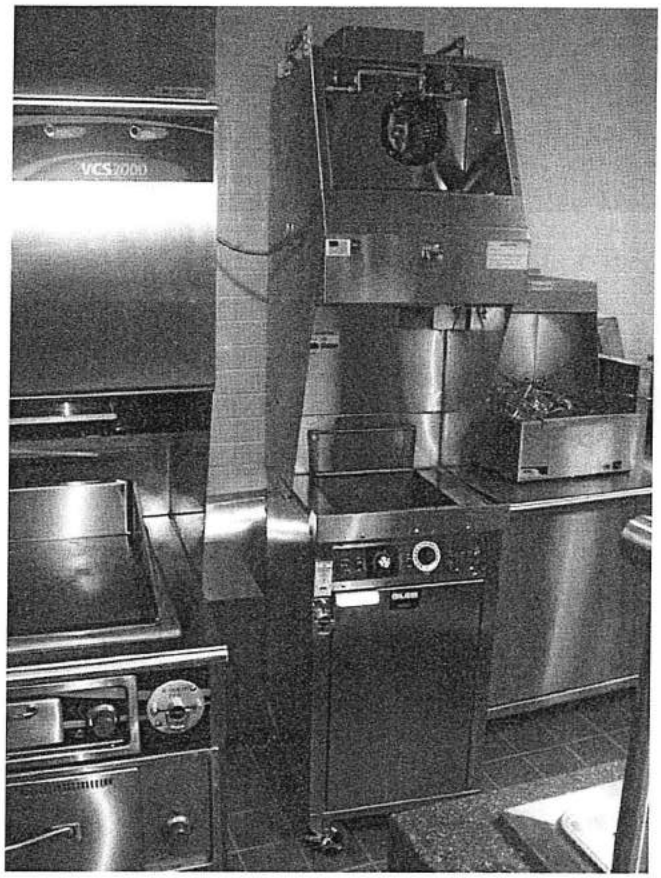


Figure 507.1(2)
ELECTRIC DEEP FAT FRYER WITH RECIRCULATING HOOD

that require a commercial kitchen exhaust system are: deep fryers; griddles (flat or grooved); tilting skillets or woks; braising and frying pans; charbroilers; salamander and upright broilers; infrared broilers; open burner stoves and ranges; and barbecue equipment.

A useful way to determine when a Type I or II hood is required for a particular type of cooking appliance is to look at the appliances listed in the definitions of "Extra-heavy duty," "Heavy-duty," "Medium-duty" and "Light-duty" cooking appliances. Once the appropriate definition for a particular cooking appliance is determined, then Section 507.13 can be used as a guide to determine what type of hood should be installed above the cooking appliance. Note that in Sections 507.13.1 through 507.13.4, the type of hood(s) to be used with each type of appliance is indicated in each of the sections. For example, an open deep fat gas fryer is listed in the definition of a "Medium-duty cooking appliance." In Section 507.13.3, medium-duty cooking appliances are associated only with a Type I hood. Note that Section 507.13 is the minimum net airflow requirements for unlabeled factory-built hoods and shop/field-constructed hoods that are not tested in accordance with UL 710.

It should be noted that a pasta cooker is listed in the definition of a "Medium-duty cooking appliance." It is not readily apparent why a pasta cooker is considered a medium-duty cooking appliance since it is not associated with the production of grease (see commentary, Section 507.2.2). Also listed as medium-duty cooking appliances are gas or electrical rotisseries. Many supermarkets offer take-home rotisserie chicken, usually located in the deli area, and multiple chickens can be seen cooking in a rotisserie, which might need to be located under a Type I hood.

A common question that is asked is, what type of hood is required for conveyor and deck-style pizza ovens? Conveyor-type pizza ovens are listed in the definition of "Medium-duty cooking appliances." Medium-duty cooking appliances are associated with a Type I hood in Section 507.13.3. Deck-type pizza ovens are listed in the definition of "Light-duty cooking appliances." In Section 507.13.4, light-duty cooking appliances are associated with a Type I hood unless they are approved for use under a Type II hood. Considering that a deck-style pizza oven is an enclosed oven and that the primary byproduct given off is heat, most deck-style pizza ovens have been approved for use under a Type II hood.

Unusual circumstances sometimes arise that may

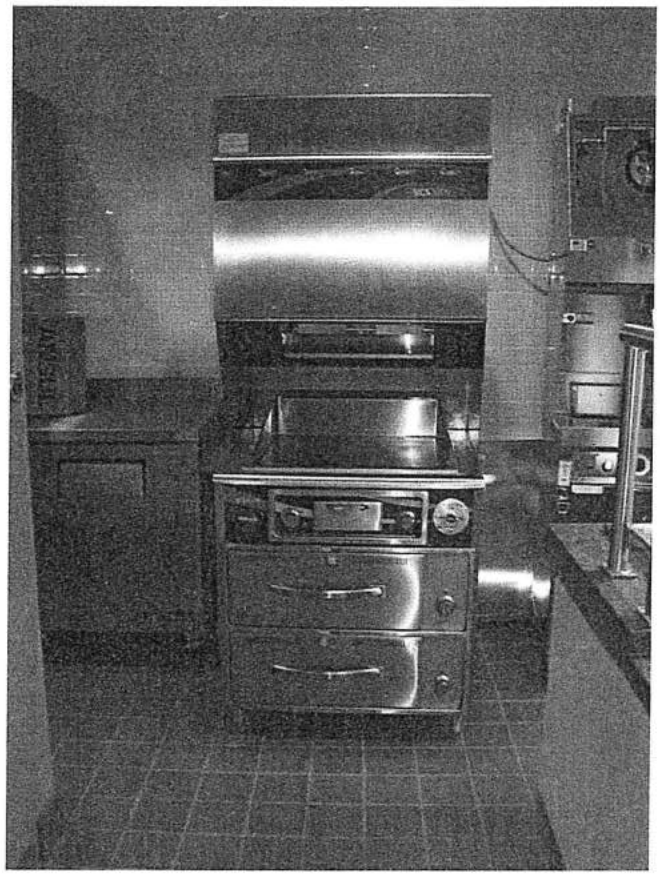


Figure 507.1(3)
ELECTRIC GRIDDLE WITH RECIRCULATING HOOD

warrant a close evaluation of a cooking appliance or a cooking appliance installation before determining whether a Type I hood is required. For example, cooking appliances used in a way that does not produce significant amounts of grease-laden vapors or smoke may need to be equipped only with a Type II hood or, depending on the occupancy where the cooking appliance is located, a residential hood or no hood at all. The key issues in making such determinations are the frequency of use and the quantities of grease-laden vapor produced by the cooking appliance and the cooking operation. The following are examples of kitchens serving occupancies that, depending on the nature of the cooking and the code official's interpretation of this section, might require only a Type II hood, a residential-type hood or no hood at all for the cooking appliances: church assembly halls; child care facilities; office or factory lunch rooms; employee break rooms; police and fire stations; bed-and-breakfast lodgings; VFW and similar halls; domestic-type kitchens in institutional occupancies; cooking classrooms; cooking demonstration displays and charity soup kitchens.

The code official should examine the frequency, duration and nature of cooking operations before determining whether a Type I or II hood is required for a particular cooking appliance or a cooking appliance installation. Bear in mind the primary purpose of a Type I hood is to control a potential fire hazard associated with grease and the purpose of a Type II hood is to control waste heat and moisture that burden HVAC systems and promote an unhealthy workplace. Excess moisture can deteriorate building components, promote the growth of mold and fungi and create unhealthy and uncomfortable working conditions for employees.

Some common scenarios that come up are the type of hoods that are required in a life science classroom in a high school (i.e., a classroom used to teach, among other things, cooking to students) and the type of hood required over a cooking appliance(s) in a fire station. In both cases, the type of cooking is the deciding factor on the type of hood required.

Typically, students in a life science class are learning to prepare meals that are the same as those that are prepared for a family in a residential dwelling unit. In most cases, residential-type range/ovens are installed in the classroom. As such, the same byproducts that are produced in a kitchen in a dwelling unit would be produced in the classroom. Based on the

residential style of cooking that is being taught, it would seem appropriate that the same type of hood installed in a residential dwelling could be installed over the residential range/ovens used in a classroom. Therefore, a Type I or II hood would not be required and residential kitchen hoods that are ducted to the outdoors could be installed.

Note that if the high school offers a culinary arts class and uses commercial cooking appliances to teach students how to prepare meals that are normally prepared in a restaurant, then the appropriate Type I or II hood could be required based on the type of cooking operations that are performed under the hood.

In the case of a kitchen located in a fire station, once again it depends on the type of cooking and the intended use of the facility. Meals prepared in a kitchen in a fire station that has a residential-type range/oven that is only intended to be used to prepare meals for the fire fighters on that particular shift is similar, if not the same, as those prepared in a home environment. As such, the same byproducts that are produced in a kitchen in a dwelling unit would be produced in the kitchen in the fire station. Based on the residential style of cooking that is being performed, it would seem appropriate that the same type of hood installed in a residential dwelling could be installed or, in a case where the space meets its ventilation requirements in Chapter 4 of the code, no hood at all.

It is not uncommon, however, for fire stations to have a community room with a kitchen used for preparing meals. The community room is often used to hold fund-raising events, such as spaghetti dinners, fish fries or pancake breakfasts or used by members of the community for special events such as parties or weddings. The kitchen may or may not have commercial cooking appliances installed. In this case, it would appear that such a situation is intended for the preparation of food for revenue generation. In this case, a Type I or II hood is required based on the cooking operations that are performed under the hood. This would also apply to VFW and other fraternal organizations, church assembly halls and other similar halls.

It is important to note that cooking appliances installed in commercial occupancies do not necessarily require the installation of a Type I or II hood. There are a number of installations in a commercial occupancy where residential-type cooking occurs that would not require a commercial kitchen hood (see the discussion above for school classrooms and fire stations). Lunchrooms and breakrooms in commercial businesses often have residential ranges/ovens installed. In addition, many multiple-family residential buildings (e.g., condominiums and townhomes) have a clubhouse or community room that the residents can reserve for special functions. Typically these are seldom used, and when they are, it is to warm food or bake frozen food like pizza, lasagna or premade appetizers. Based on the residential style of cooking that is performed on these appliances, it would seem appropriate that the same type of hood installed in a residential dwelling could be installed or there may be no hood at all.

If multiple cooking appliances are installed under a single hood and one or more of those appliances requires a Type I hood, a Type I hood would be required to serve the entire appliance line.

With the trend for larger kitchens in new dwelling units, kitchens designed with commercial-type cooking appliances have become more popular. Although these installations would generally not require commercial exhaust hoods, commercial appliances should be carefully evaluated for use in dwellings. Commercial cooking appliances are typically not listed for domestic use and might lack certain safety features that would be required for domestic cooking appliances. Note that Sections 917.2 and 917.3 require appliances in dwelling units to be designed and listed for domestic use (see commentary, Sections 917.2 and 917.3).

This chapter does not require exhaust hoods for cooking equipment or appliances installed outdoors where the grease-laden vapors, etc., discharge directly to the outside atmosphere.

507.2.1.1 Operation. Type I hood systems shall be designed and installed to automatically activate the exhaust fan whenever cooking operations occur. The activation of the exhaust fan shall occur through an interlock with the cooking appliances, by means of heat sensors or by means of other approved methods.

❖ This section states that the hood system must operate whenever cooking operations are taking place. In order to perform the intended function, a Type I hood is required to automatically operate when cooking operations occur. There are several methods indicated to achieve this and it is left up to the designer/installer/owner and code official to determine what they all agree will be necessary to verify that fan operation will occur whenever cooking operations occur.

The activation of the exhaust fan must occur through an interlock with the appliances, by means of heat sensors or other approved methods. It should be noted that an interlock with the cooking appliances is one of the methods to accomplish this, but is not the only method. This text has been misinterpreted as meaning that all appliances must be fitted with controls that would start the hood system. This is not the case. In fact, tampering/altering with listed and labeled appliances may in itself create a code violation. However, if a cooking appliance had provisions incorporated into its listed and labeled design that included some type of interlock option, that would certainly meet the requirements of this text.

It should be pointed out that the text states that "hood systems shall be designed and installed..." This means the hood system needs the controls and not necessarily the actual cooking appliances. The hood system must interlock with appliances by means of heat sensors or other approved methods. All this means is that something needs to activate the exhaust

fan when a cooking operation takes place. This can be achieved through the use of controls such as heat sensors/infrared technology, light beam interferance detection or through methods such as electric relays that control the branch circuit that the appliances are connected to or, in the case of gas appliances, maybe a solenoid valve.

The last part of this code text leaves the door open to just about everything by saying, "or by other approved methods." This leaves it up to the designer/installer/owner and code official to determine what will be necessary to verify that fan operation will occur whenever cooking operations take place. One way might be to interlock the fan to the lighting control serving the kitchen area. This option may work very well because of the allowance that permits the use of variable speed exhaust fans (see commentary, Section 507.1). So when the lights are turned on the fan might not even be running, but when cooking operations begin the heat created would cause the fan to begin to run on a light load condition. This variable speed technology already has the interlock incorporated into it, which is how the fan knows to automatically change speeds throughout the day. Another "approved" method may be one that some of the chain restaurants use in which the standard operating procedure is that the fan always runs when the building is occupied or upon startup of any cooking appliance.

507.2.2. Type II hoods. Type II hoods shall be installed where cooking or dishwashing appliances produce heat, steam, or products of combustion and do not produce grease or smoke, such as steamers, kettles, pasta cookers and dishwashing machines.

Exceptions:

1. Under-counter-type commercial dishwashing machines.
2. A Type II hood is not required for dishwashers and potwashers that are provided with heat and water vapor exhaust systems that are supplied by the appliance manufacturer and are installed in accordance with the manufacturer's instructions.
3. A single light-duty electric convection, bread, retherm or microwave oven. The additional heat and moisture loads generated by such appliances shall be accounted for in the design of the HVAC system.
4. A Type II hood is not required for the following electrically heated appliances: toasters, steam tables, popcorn poppers, hot dog cookers, coffee makers, rice cookers, egg cookers, holding/warming ovens. The additional heat and moisture loads generated by such appliances shall be accounted for in the design of the HVAC system.

❖ Commercial cooking appliances that require Type II hoods as opposed to Type I hoods produce little, if any, grease-laden vapor. Some examples include light-duty cooking appliances such as convection ovens, bread ovens or deck-style pizza ovens and appliances that produce only steam. Dishwashing machines and other auxiliary food heat-processing appliances that do not produce grease-laden vapors such as warming ovens are also suitable for Type II hood installations.

It should be noted that a pasta cooker is listed in the definition of a "Medium-duty cooking appliance," which requires a Type I hood. A pasta cooker is also listed in this section as requiring a Type II hood. It is not readily apparent why a pasta cooker is considered a medium-duty cooking appliance since it is not usually associated with the production of grease. It would appear that a pasta cooker would be more appropriately located under a Type II hood as required by this section.

Type II hoods are generally of two types: condensate hoods and heat/fume hoods. They are used for applications with high moisture loads, heat/fume loads, unique aromas or various combinations, but with little to no grease.

Exception 1 exempts under-counter dish- washing machines because of the minimal water vapor they produce. Some dishwashing machines, however, have factory-supplied exhaust appurtenances that would make a Type II hood unnecessary.

Exception 2 exempts commercial dishwashers and potwashers with manufacturer-supplied exhaust equipment from the requirement for Type II hoods. The Type II hood would only duplicate the manufacturer-supplied exhaust system, adding an unnecessary expense. It is important that the exhaust equipment be intended for the application and installed in accordance with the manufacturer's installation instructions. Section 507.13.4 specifies exhaust rates for Type II hoods.

Exception 3 is intended to address a single light-duty electric oven that produces a minimal amount of sensible and latent heat that can be accounted for in the heating and cooling load calculations for the HVAC system. Some examples include countertop microwave and convection ovens and bread-baking ovens found in many chain sandwich shops. It should be noted that the exception specifically indicates a single appliance. Many sandwich shops have bread-baking ovens along with countertop microwave or convection ovens. Allowing more than one appliance would be a judgement call by the code official based on the type of appliances, the duration of use and the ability of heating and cooling systems to account for the additional heat given off by the appliances.

Exception 4 is intended to address electrically heated appliances that produce a minimal amount of sensible and latent heat that can be accounted for in the heating and cooling load calculations for the HVAC system. Many of the appliances listed are portable countertop-type appliances that have historically been installed without the use of a hood. As long as any heat that is generated by these appliances is accounted for in the HVAC load calculations, the health of the employees and customers can be protected.