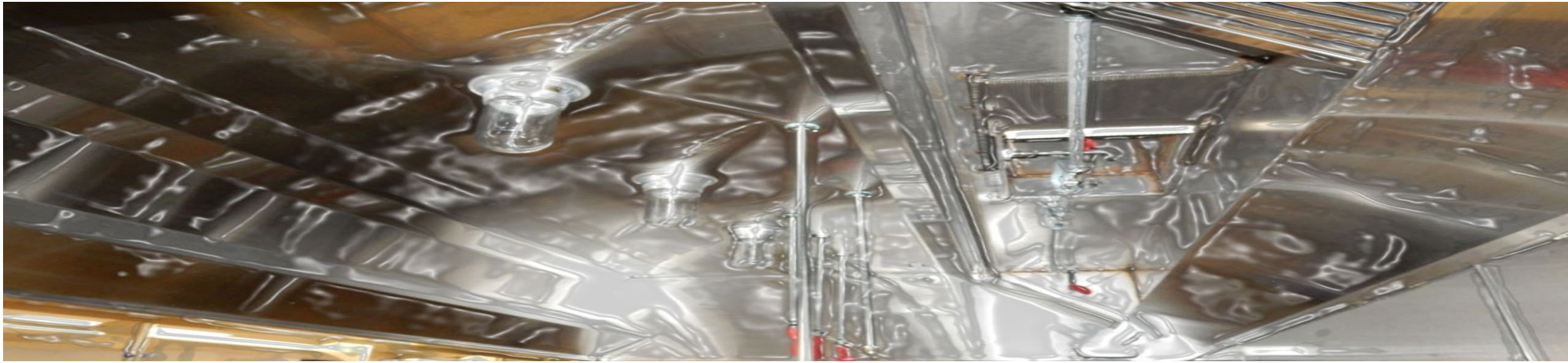
Commercial Cooking: Ventilation and Fire Control

Course Goal



Assist code officials, design professionals, contractors and builders understand the ICC codes and Connecticut amendments regulating commercial cooking exhaust hood systems.

Learning Objectives

- Define commercial cooking terms and hazards.
- Identify code requirements for commercial cooking exhaust systems.
- Describe Type I hood and grease exhaust duct acceptance tests.
- Identify requirements for commercial cooking fire suppression systems and equipment.

Course Layout

- Module 1: Definitions
- Module 2: Cooking Hazards and Controls
- Module 3: Building and Mechanical Code Construction Requirements
- Module 4: Exhaust Duct Systems
- Module 5: Commercial Hoods
- Module 6: IFC Requirements
- Module 7: System ITM

Prerequisite Knowledge

- When commercial-type cooking appliances are required to be protected.
- *International Building Code*® combustible and non-combustible construction methods.
  - IBC® Chapter 7 "Fire and Smoke Protection Features"
- *International Fire Code*®
- *International Mechanical Code*® as amended by Connecticut
- NFPA® 96 *Ventilation Control and Fire Protection of Commercial Cooking Operations*

A Word about I-Code *Words*

- Words that have special I-Code definitions are *italicized*
- Refer to Chapter 2 "Definitions"

Example: What are *extra-heavy-duty cooking appliances* in the IMC®?

Extra-heavy-duty appliances use wood, charcoal, briquettes and mesquite fuels.

Example: What does *approved* mean in the I-Codes?

Approved: Acceptable to the code official.

Module 1

Definitions

Definitions

Hood. An air intake device used to capture by entrapment, impingement, adhesion or similar means, grease, moisture, heat and similar contaminants before they enter a duct system.

Type I Hood. A kitchen hood for collecting and removing grease vapors and smoke. Such hoods are equipped with a fire suppression system.

Type II Hood. A general kitchen hood for collecting and removing steam, vapor, heat, odors and products of combustion.

“Canopy” or “Non-canopy”

- Canopy hood
  - Access to all sides
  - ≥ 6 inches beyond edge of all appliances
  - ≤ 4 feet above cooking surface

- Non-canopy hood
  - Access to three sides
  - ≤ 3 feet above cooking surface

Kitchen Hoods

- Types and configurations depend on:
  - Cuisine/cooking style
  - Production rates and traffic patterns
  - Owner/staff preference
  - Kitchen space configuration

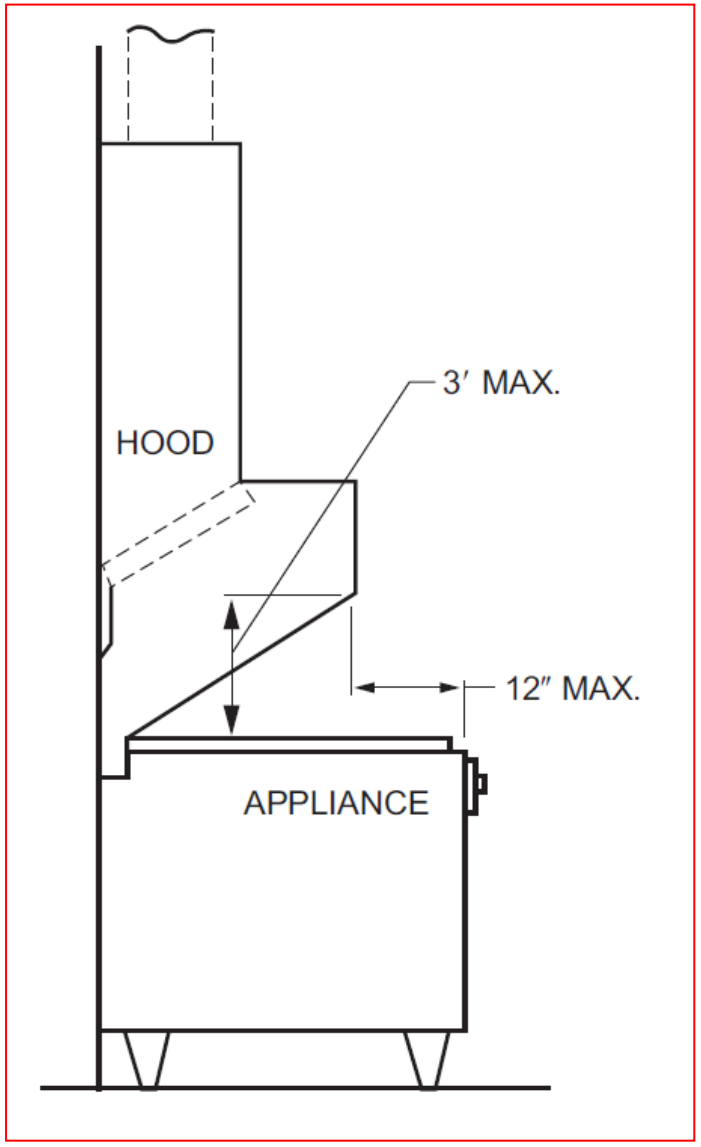
Definitions

Wall-mount Non-canopy Hood

- Mounted against a wall above a single appliance or line of appliances
  - Could be free-standing with a back panel at the rear of the appliances
  - Overhangs the front and sides of the appliances

- Wall acts as a back panel, forcing the makeup air to be drawn across the front of the cooking equipment, increasing effluent capture effectiveness

Wall-mount Non-canopy Hood

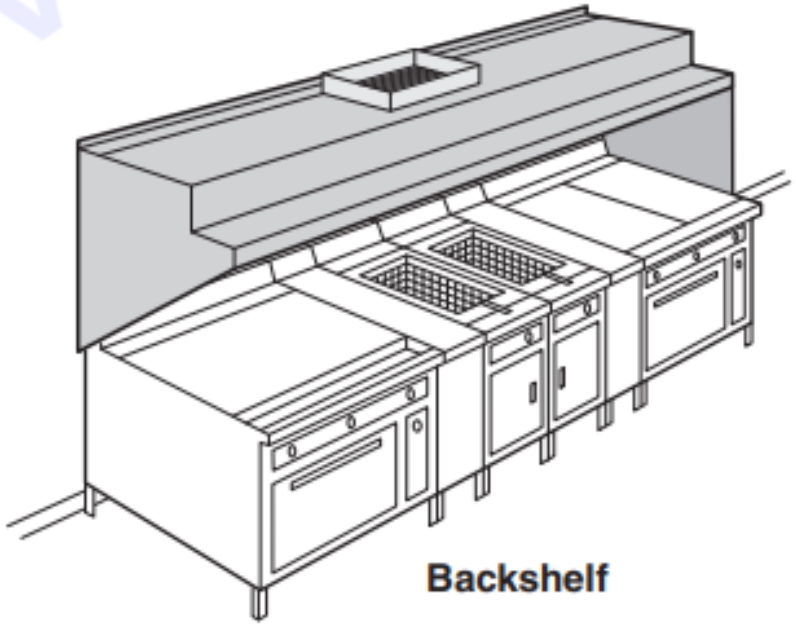


Definitions

Back-Shelf Non-canopy Hood

- Also known as a *low-proximity* or *sidewall* hood
  - Front lower lip is low over the appliances and is "set back" from the front of the appliances
- Always closed at rear of appliances
- Height above cooking surface varies
- May be constructed with partial end panels to increase effluent capture

Backshelf Non-canopy Hood



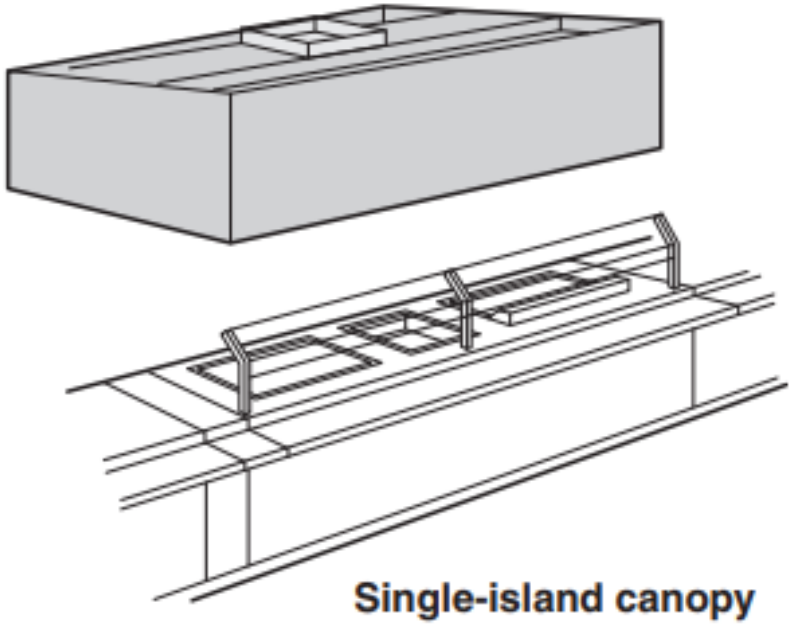
Courtesy: National Fire Protection Association©, NFPA© 96

Definitions

Single Island Canopy Hood

- Placed over a single appliance or appliance line
- Open on all sides
- Overhangs the front, rear, and sides of the appliances
- Susceptible to cross drafts
  - Needs greater exhaust air flow than equivalently sized wall-mounted canopy for effluent capture

Single Island Canopy Hood



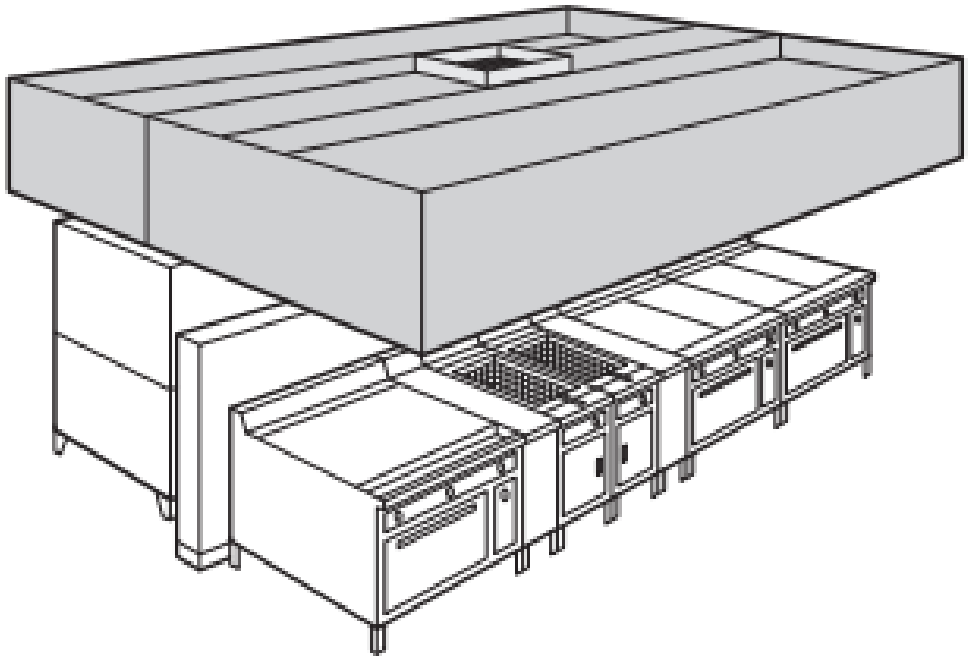
Courtesy: National Fire Protection Association©, NFPA© 96

Definitions

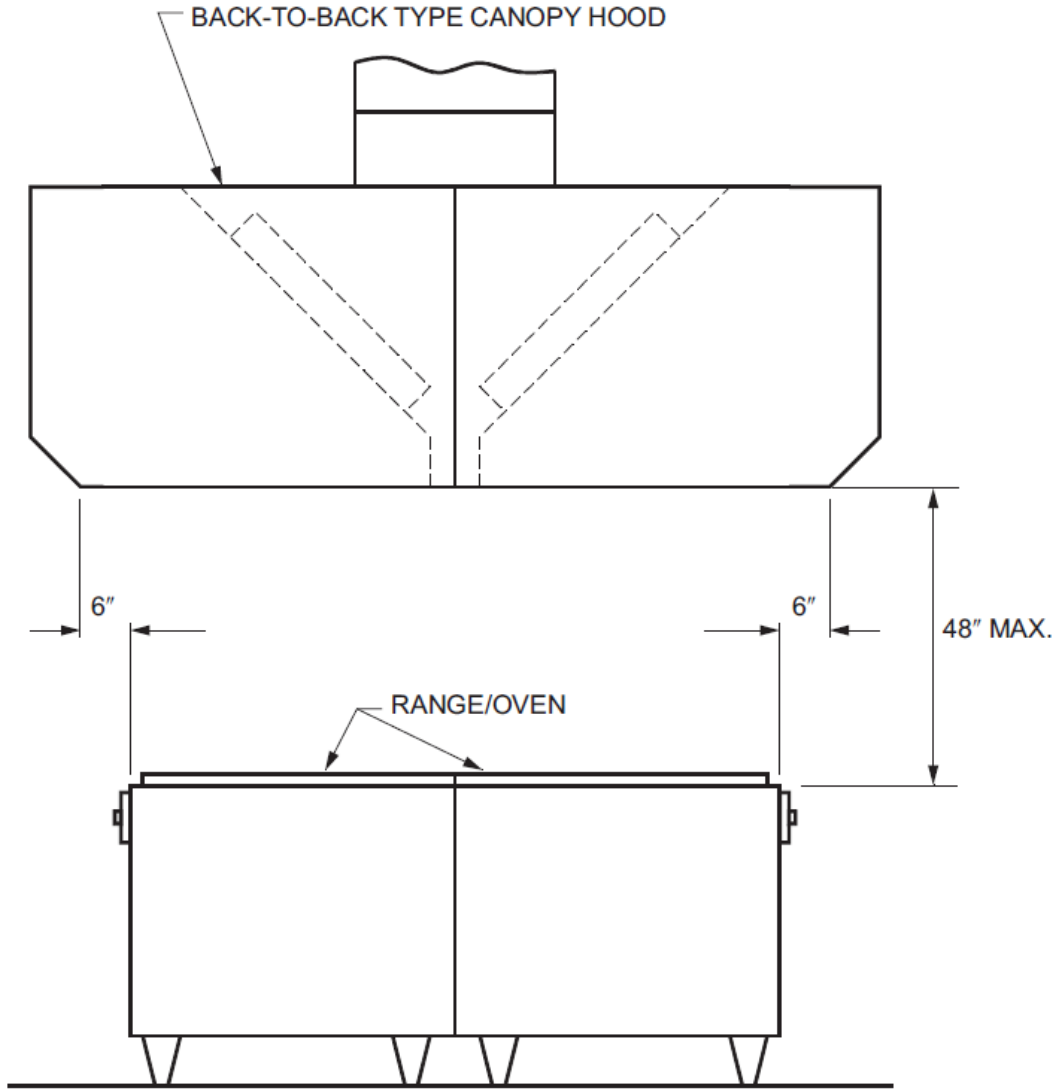
Double Island Canopy

- Installed over back-to-back appliances
- Open on all sides
- Overhangs front and all sides of appliances
- May have a wall panel between the backs of the appliances

Double Island Canopy Hood



Double-island canopy



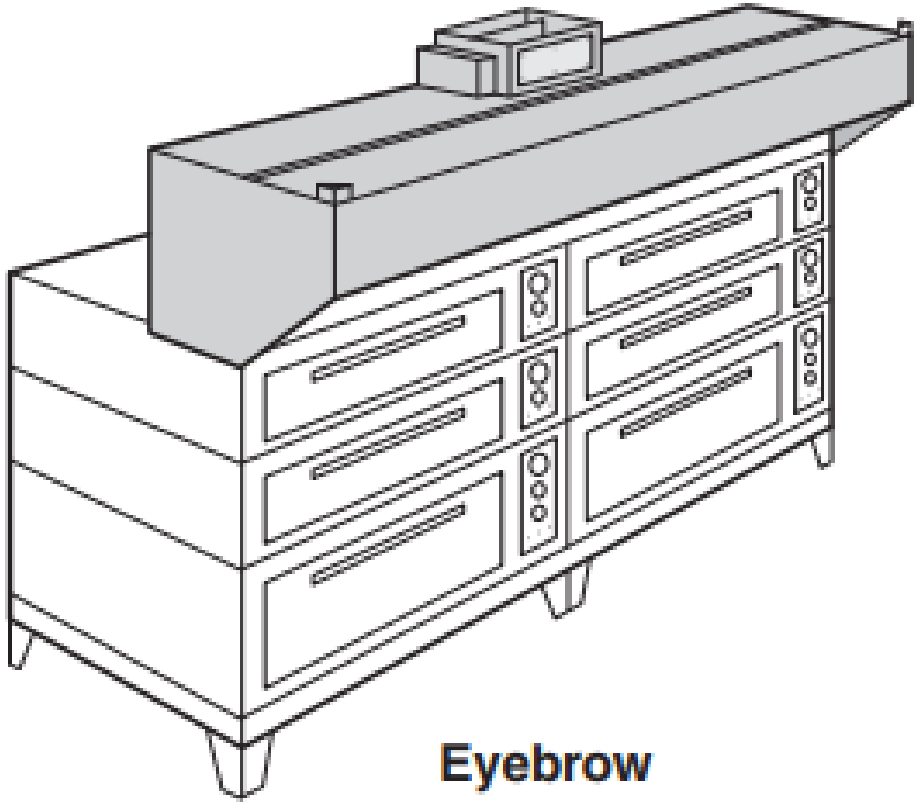
Courtesy: National Fire Protection Association©, NFPA© 96

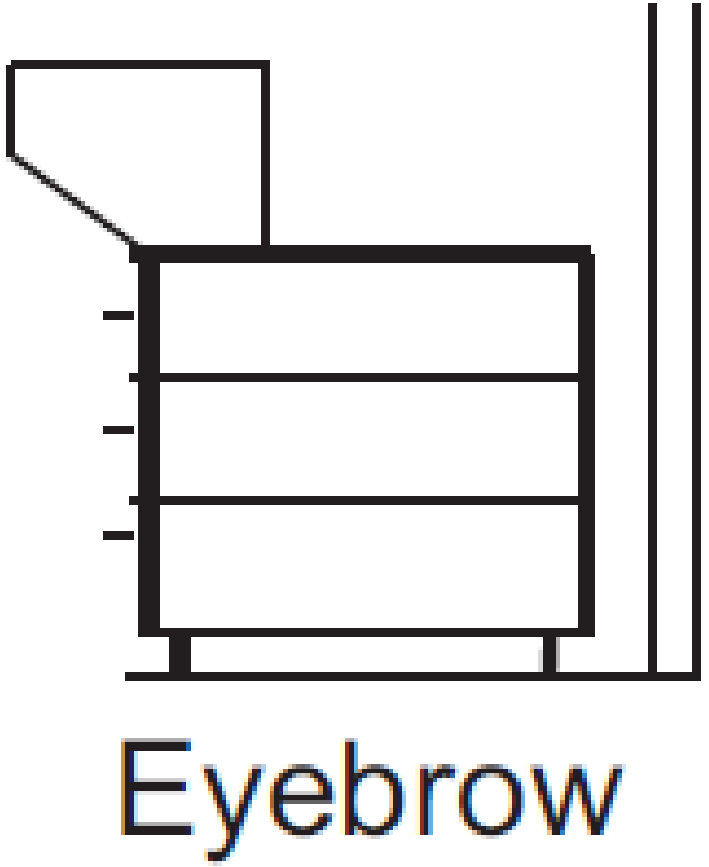
Definitions

Eyebrow Non-Canopy

- To capture effluent
  - Mounted directly to the face of appliance extends past the sides
  - Overhangs the front of the opening

Eyebrow Non-Canopy Hood



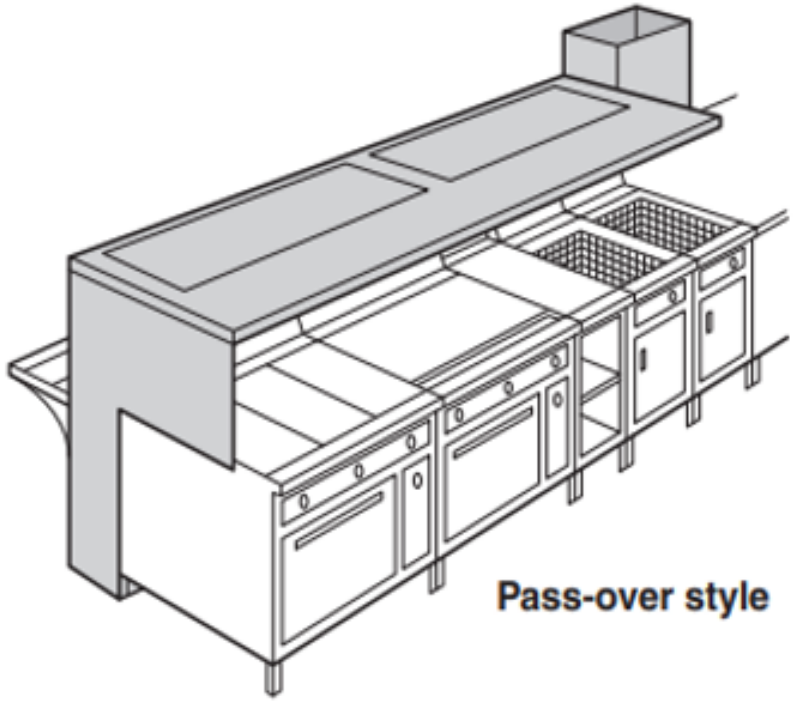


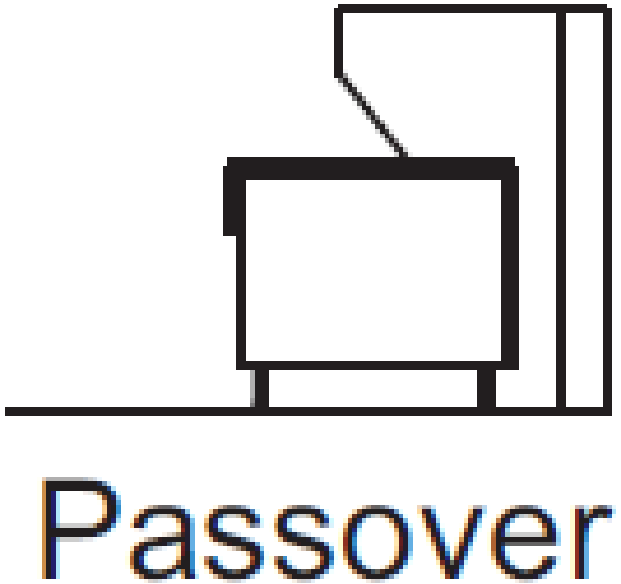
Courtesy: National Fire Protection Association©, NFPA© 96

Definitions

Pass-over Non-canopy

- Free-standing form of a backshelf hood
- Constructed low enough to pass food over the top





Courtesy: National Fire Protection Association©, NFPA© 96

Definitions

Compensating Hoods

- Integral (built-in) make-up air supply.

Definitions

Duct System. A continuous pathway for the transmission of air that - in addition to ducts - contains duct fittings, dampers, plenums, fans and accessory air handling equipment and appliances.

Make-up Air. Any combination of outdoor and transfer air intended to replace *exhaust air* and *exfiltration*.

Smoke Point. Temperature at which a cooking oil (vegetable or animal fat) will begin to emit visible smoke.

Generally, a few degrees below the oil's ignition temperature.

Definitions

Commercial Cooking Appliances. Appliances used in a commercial *food service establishment* for heating or cooking food and which produce grease vapors, steam, fumes, smoke or odors that are required to be removed through a local exhaust ventilation system…

Food service establishment: any building or a portion of it used for food preparation and serving.

Cooking appliance "service types" are used to determine ventilation requirements.

Definition

Courtesy: USA Today

Extra-Heavy-Duty Cooking Appliance

- Appliances using solid fuel as the primary heat
  - Wood, charcoal, briquettes and mesquite

Definition

Heavy-Duty Cooking Appliance

- Gas under-fired broilers
- Gas chain (conveyor) broilers
- Gas open-burner ranges
  - With or without oven

(See back-up slides for complete list)

Definition

Medium-Duty Cooking Appliance

- Electric discrete element & hot top ranges
- Electric and gas griddles
- Electric and gas double sided griddles
- Electric and gas fryers

(See back-up slides for complete list)

Definition

Light-Duty Cooking Appliances

- Electric and gas ovens
- Electric and gas steam-jacketed kettles

(See back-up slides for complete list)

Module 2

Cooking Hazards and Controls

Key Performance Objective

- Mechanical commercial kitchen hoods remove cooking combustion products
- Maintain comfort and safety for kitchen personnel
  - Provide controlled environment for food preparation

Kitchen Personnel Safety

- Safety and comfort can be adversely affected by excess heat, humidity, smoke and grease-laden cooking effluents

- Scientific studies suggest that exposure to cooking fumes can result in breathing-related disorders:
  - Chronic obstructive pulmonary disease (COPD)
  - Lung cancer

Food Safety

- Properly designed mechanical ventilation system limits temperature and humidity
  - Reduces pathway for allergens and food-borne pathogens growth and spread

Commercial Cooking Fire Hazards

- Restaurants pose significant fire risks
  - Large occupant load
    - Unfamiliar surroundings
    - Alcohol impairment
  - Little or no fire resistive separation
    - Kitchen to adjacent spaces
  - Combustible construction and storage
  - Combustible decorations and furnishings

Courtesy: Hood Filters.com

Commercial Cooking Fire Hazards (cont'd)

- Ignitable grease and effluent vapors
  - Exhaust duct fires: 1452-2000°F
- Equipment or processes as ignition source
    - Open flame
      - Combustible, heated liquids
        - Cooking oils and additives
      - Combustible solids
    - Heated surfaces
    - Electrical arcs
    - Overheated refrigeration equipment

Cooking Oils: Combustible Class IIIB Liquids

Cooking Oil	Flash Point Temperature (°F)	Smoke Point (°F)	Ignition Temperature (°F)
Canola Oil	450	375-450	626
Corn Oil	490	352	740
Cottonseed Oil	486	420	650
Palm Oil	323	455	600
Peanut Oil	540	320	833
Soybean Oil	549	350-460	833
Sunflower Seed Oil	550	320-450	Undetermined

Solid Fuel Fire Hazards

- Hardwoods
  - Mesquite or hickory
  - Charcoal or briquettes
- Ignition temperatures 500–700°F
- Produce more smoke than oils
  - Cooking temperatures too low for clean combustion
  - Creosote build-up in chimneys
- Solids require cooling when ignited

Module 3

Building and Mechanical Code Construction Requirements

IBC Requirements

- IBC Chapter 7
  - Fire-resistive or non-combustible construction requirements
    - Shafts
    - Shaft enclosure protectives
    - Fire barrier construction standards

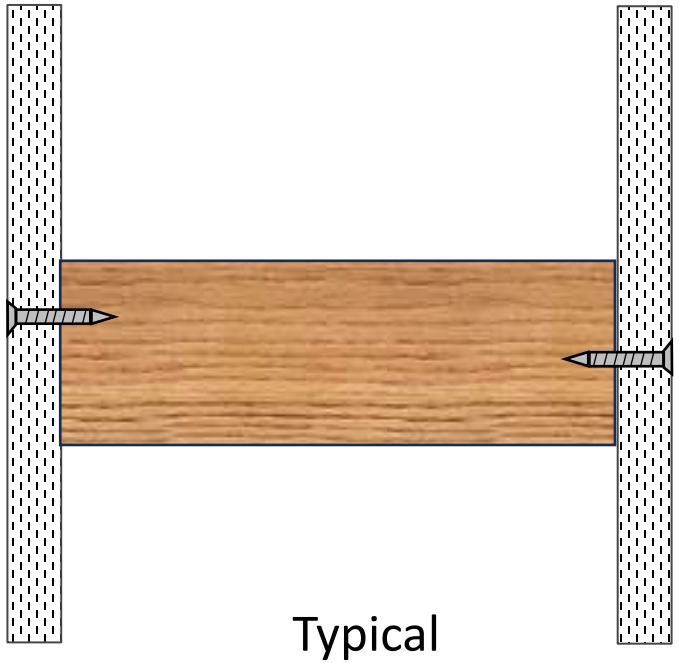
- IBC Chapter 28
  - Cross-references to *International Mechanical Code*

Shaft Construction: IBC §713.4

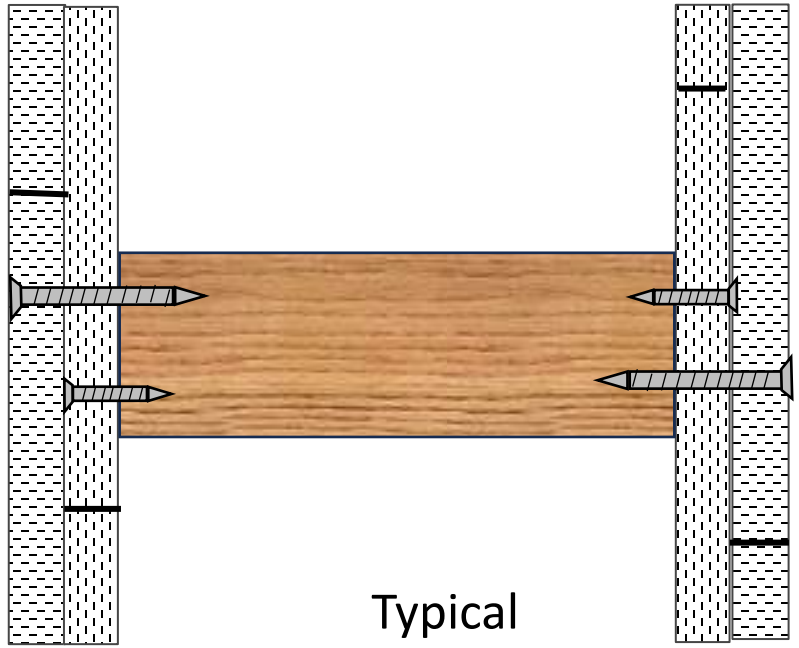
- If required
  - Constructed as fire barriers
    - Fire-resistant rated assembly
    - Tested per UL 263 or ASTM E119
  - Rating
    - Two-hour for four or more stories
    - One-hour less than four stories
  - Openings/penetrations only for purpose of the shaft (e.g. cleanout access)

Limited Combustible Shaft: IBC §713.4

Typical: Nominal 2x4



Typical
One-hour
One layer 5/8-inch Type X GWB
Both Sides



Typical
Two-hour
Two layer 5/8-inch Type X GWB
Both Sides with Alternate Direction
Overlapped Joints

Grease-Duct Clearances: CT IMC § 506.3.6

Construction	Clearance (in.)
Combustible	18
Limited-combustible (GWB)	3
Non-combustible	0

Exceptions:

- Factory-built commercial kitchen grease ducts listed and labeled in accordance with UL 1978, *Standard for Safety Grease Ducts*.
- Grease duct systems or exhaust equipment listed for clearances less than these to be installed per listings.
- §506.3.6 clearances may be reduced in accordance with IMC §308. (See back-up slides)

Ceramic Duct Wrap Alternate

Courtesy: Unifrax.com

- ASTM E2336, *Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems*
- Clearances to meet listing

Opening Protectives: IBC §716

- Shaft enclosure openings must be protected Table 716.5
  - Same as IMC §607.5.2

Fire Suppression: IBC §904.12

- Type I hood and duct system must be protected
  - See also IMC §509.1 and IFC §904.12

Fire Suppression IBC §904.12

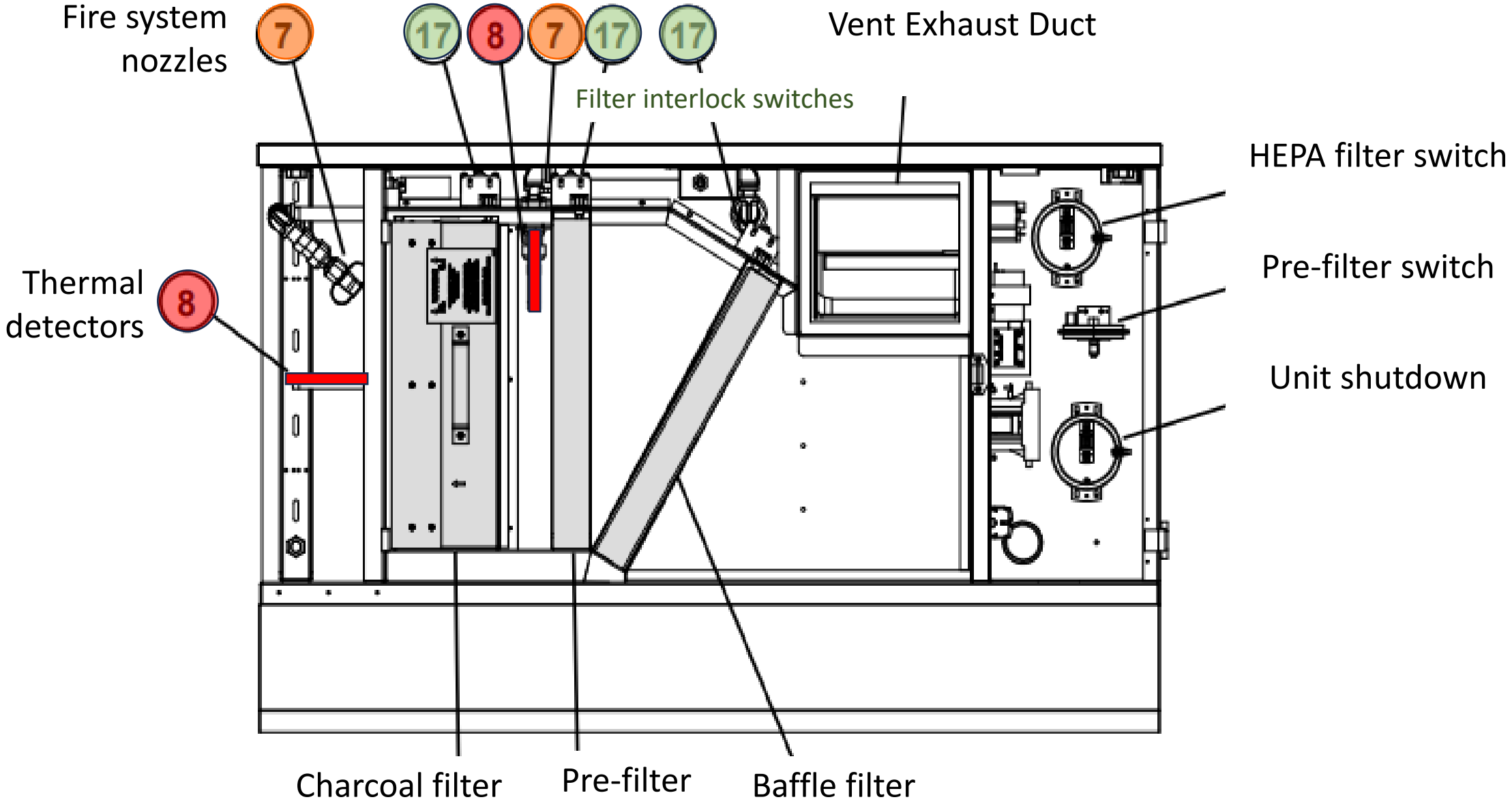
- Must meet UL 300 *Commercial Cooking Protection*
- Equipment must be listed and labeled
- Automatic and manual release
- Cooking equipment fuel/electrical shut down
- Special provisions for
  - Carbon dioxide systems
  - Automatic sprinkler systems
    - Need not meet UL 300

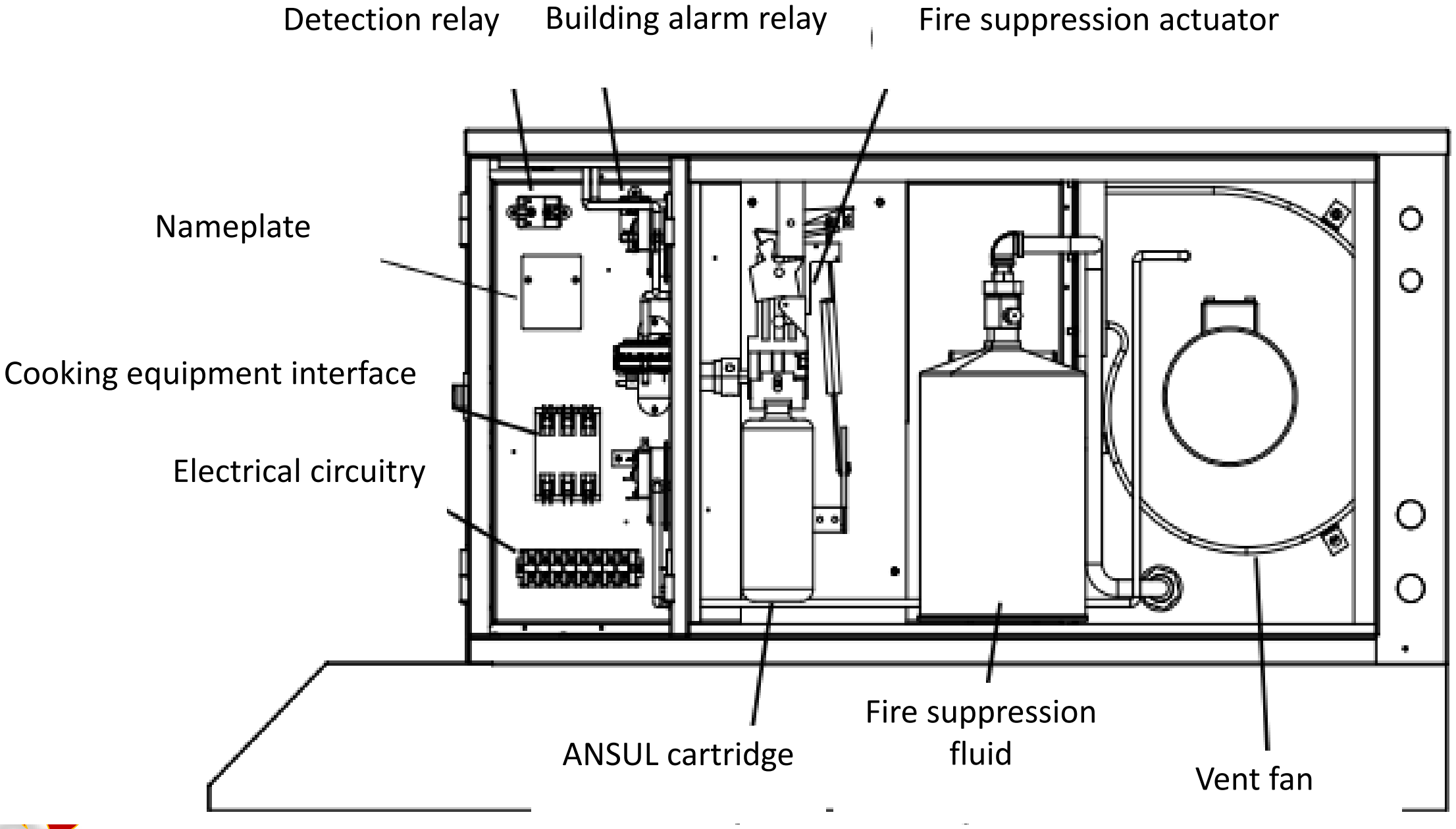
Fire Equipment Exception

Courtesy: Wells Manufacturing, LLC

Factory-built "recirculating" systems

- Tested, listed and labeled per UL 710B *Standard for Recirculating Systems*
- Installed per manufacturer and *International Mechanical Code* §301
  - Built-in fire actuated damper and fire extinguishing system


Fire system nozzles
7
17
8
7
17
17
Vent Exhaust Duct
Filter interlock switches
HEPA filter switch
Thermal detectors
8
Pre-filter switch
Unit shutdown
Charcoal filter
Pre-filter
Baffle filter


Detection relay
Building alarm relay
Fire suppression actuator
Nameplate
Cooking equipment interface
Electrical circuitry
ANSUL cartridge
Fire suppression fluid
Vent fan

International Mechanical Code

- Regulates design, installation, maintenance and alteration of mechanical appliances and building mechanical systems that are used to control the environment and related processes
  - Chapters 3-5 for commercial cooking

IMC Chapter 3: Equipment

- General requirements
  - ~~IMC §301.6 - Fuel gas equipment and piping per *International Fuel Gas Code*~~
    - CT amendment to NFPA 54, *Fuel Gas Code*, 58 *LPG* and 2 *Hydrogen*
  - IMC §301.7 - Appliances and equipment must be listed and labeled.
  - IMC §301.10 – Electrical installations per NFPA 70, *National Electrical Code*.
  - IMC §302.1 – Structural integrity not to be compromised by mechanical equipment.

IMC Chapter 4: Ventilation

- Establishes minimum means for protecting building occupants' health
  - Controls the quality of the indoor air
  - Removes harmful contaminants
- Minimum outside air ventilation rate of 0.7 cfm/ft^2 of net occupiable floor area
- Air captured by hood must discharge to the exterior and not recirculated

IMC Chapter 4: Ventilation

- IMC §401 – General ventilation requirements for occupied structures
- IMC §401.4 – Air intake opening locations must be
  - At least 10 feet from
    - lot lines/adjacent buildings
    - hazardous or noxious contaminant sources
  - At least three feet below
    - contaminant sources within 10 feet of building

IMC Chapter 5: Exhaust Systems

- IMC §506 – Distinguishes Type I and Type II exhaust systems

Type I

- Continuous, confined path to outdoors for fire control
  - Grease or smoke
  - Heat, odors and steam
- Independent systems
- Heavy-duty duct materials
  - Leak-proof joints
  - Cleanouts
- Clearance from combustibles
- Minimum air flow rates

Type II

- Human comfort
  - Heat, odors and steam
- Lightweight duct materials
  - Rigid metallic materials
- No minimum air flow rate
- Construction per IMC Chapter 6

NFPA 54/58 (CT IMC §101.2 and §301.6)

- Installation of
  - Natural gas and LP-gas systems
  - Fuel gas utilization equipment/appliances
    - From the utility company's delivery point to appliance shutoff valve.
  - Covers pipe sizing and arrangement, approved materials, installation, testing, inspection, operation and maintenance

- Includes
  - Combustion and ventilation air,
  - Approved venting, and,
  - Fuel gas system connections.

Module 4

Exhaust Duct Systems

Exhaust Duct Systems

- Construction
  - Materials
  - Joints
  - Connections
  - Supports
- Clearances and enclosures
- Maintenance features
- Ventilation rates

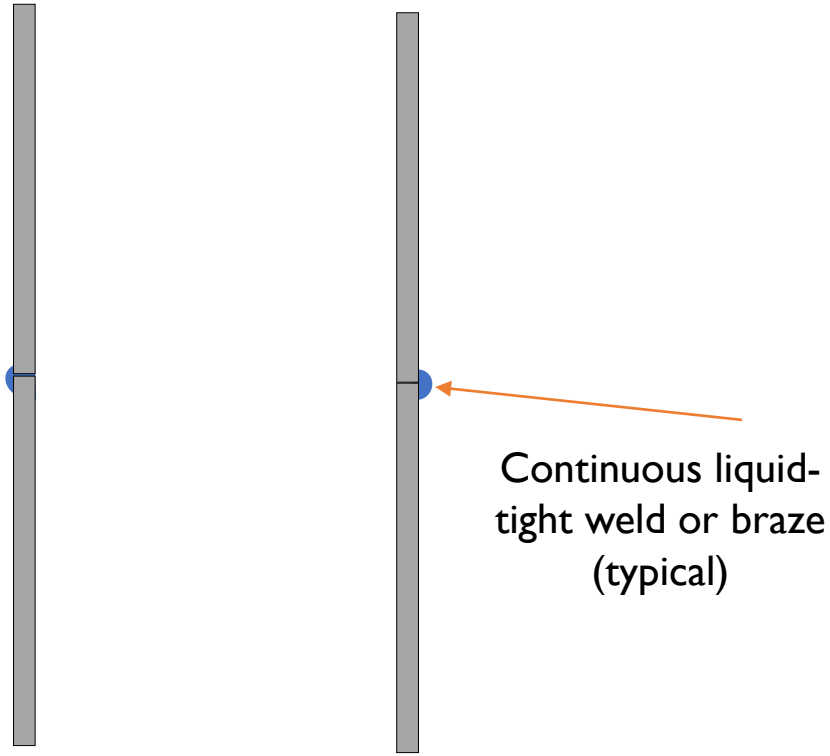
Duct Construction: IMC §506.3.1

- Grease ducts
  - No. 16 gage steel (0.0575-inch)
  - No. 18 gage stainless steel (0.0450-inch)
- Non-combustible supports
- Make-up air ducts
  - Connected or within 18 inches of Type I hood
    - See IMC §603
- Joints
  - Continuous liquid-tight weld or braze, or,
  - Factory built, listed, labeled per UL 1978

Makeup Air Ducts: IMC §506.3.1.2

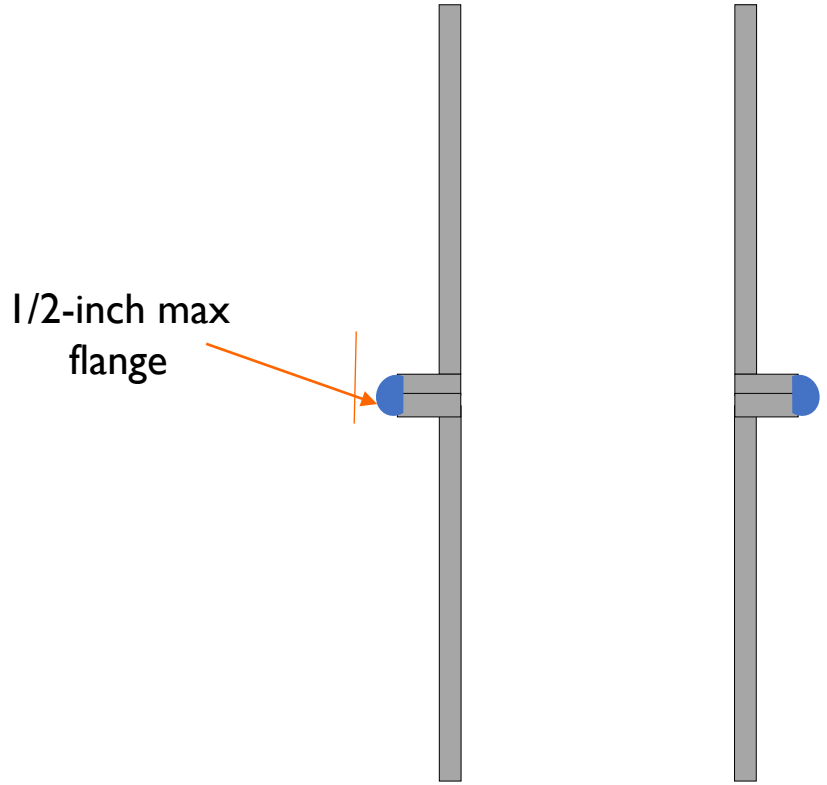
- Make up air ducts connected to or within 18” of a Type I hood constructed and installed in accordance with IMC Chapter 6
- Conditioned make-up air
- Duct insulation ≤18” from a Type I hood:
  - noncombustible, or,
  - listed for the application.

Duct Joint Types: IMC §506.3.2.1



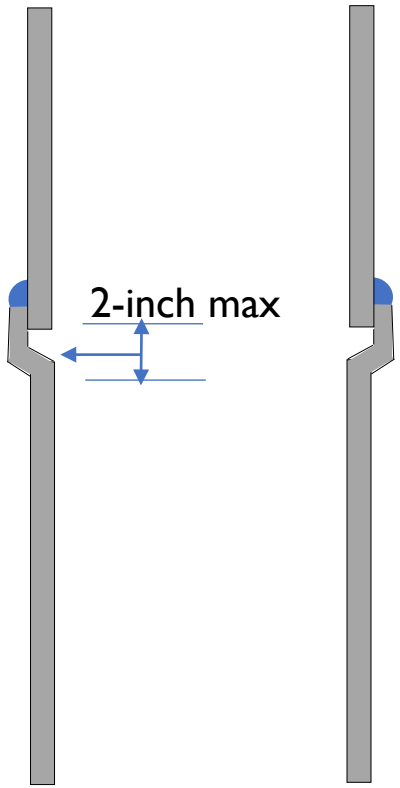
Continuous liquid-tight weld or braze (typical)

Butt Joint

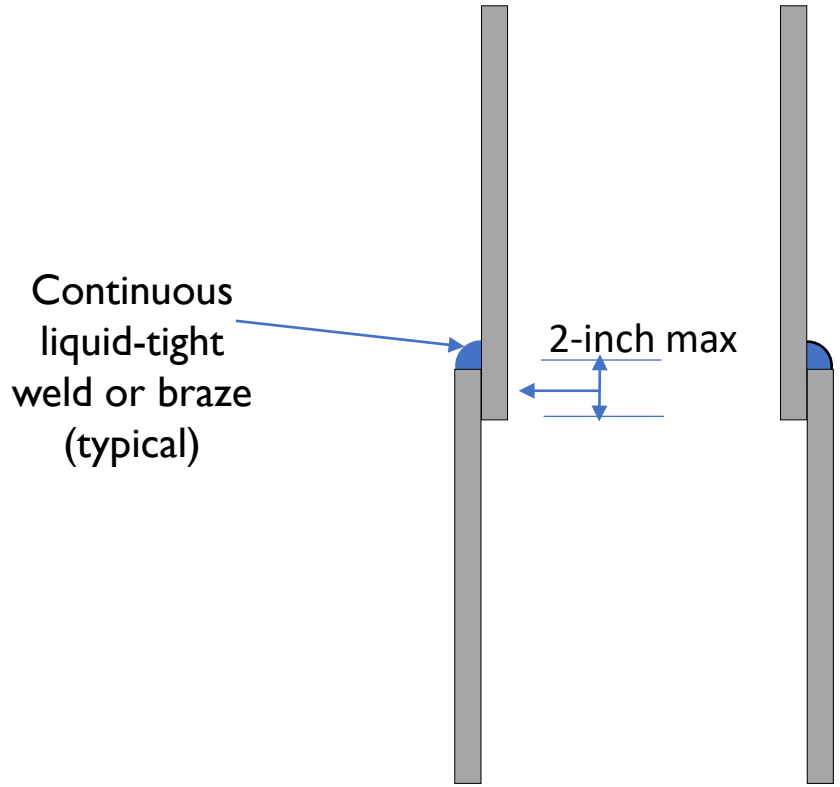


Flange Joint

Duct Joint Types: IMC §506.3.2.1



Bell Joint

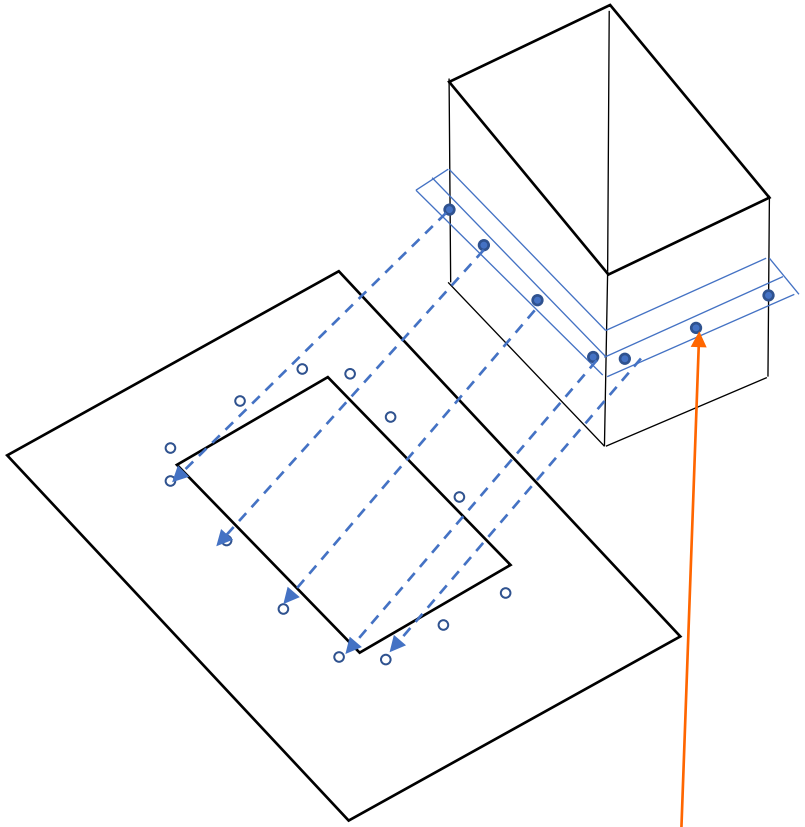


Telescoping Joint

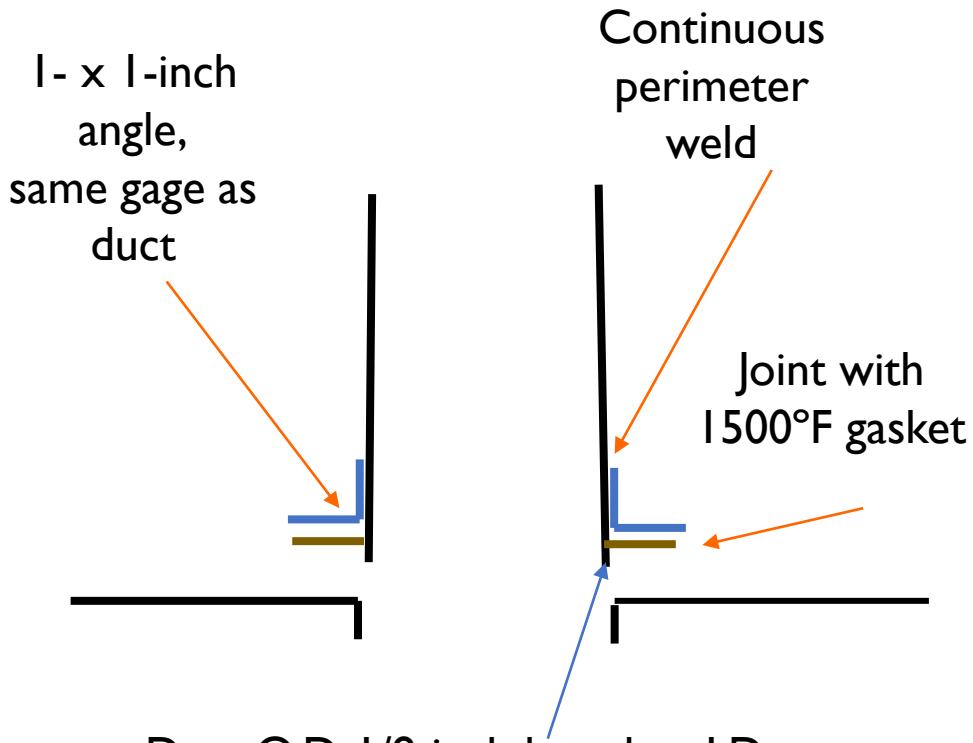
Duct-to-Hood Connection

- IMC § 506.3.2.2
  - Liquid-tight
    - Welded or brazed
  - Exception for duct-to-hood collar connection
    - Prescriptive
    - Listed/labeled

Prescriptive Duct-to-Hood Collar



¼-inch weld studs or bolts,
each corner and four-inch max O.C.



Duct O.D. 1/8-inch less than I.D.
of hood collar

(Section View)

Ventilation Rate: IMC §506.3.4

- Minimum air velocity of 500 fpm for ducts serving Type I hoods
- No velocity prescribed for ducts serving Type II hoods

Duct Separation: IMC §506.3.5

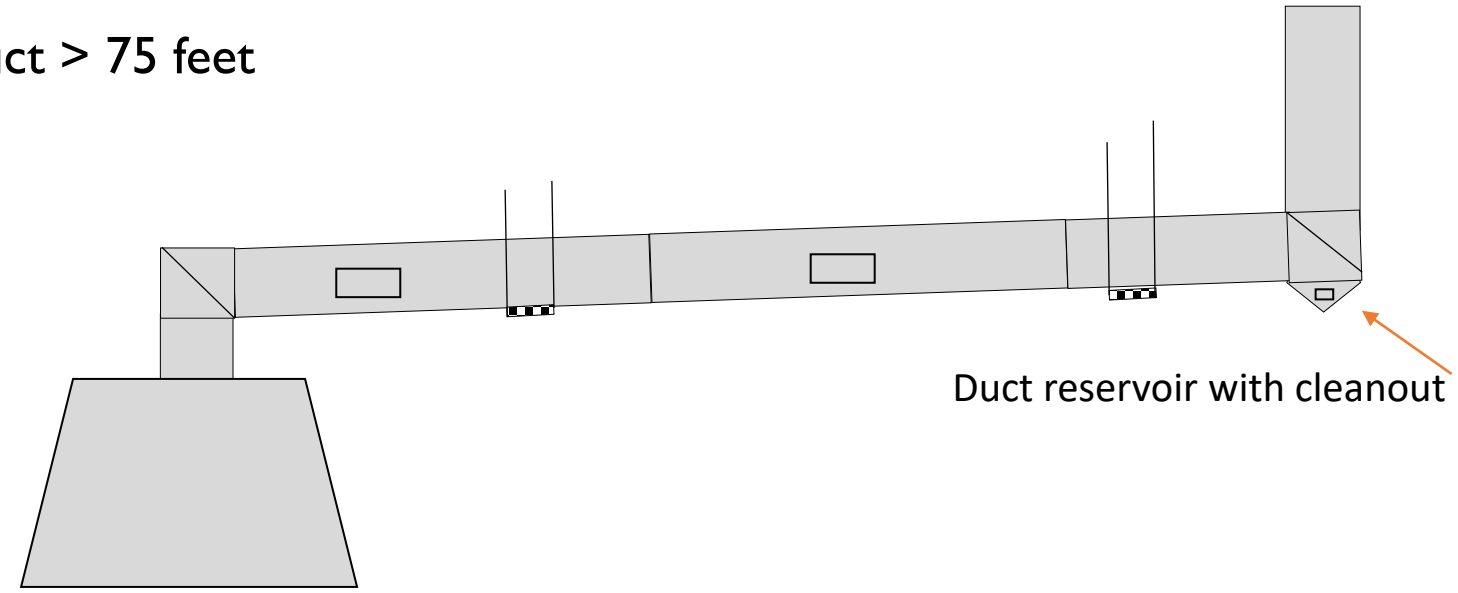
- Type I systems must be independent from all other exhaust systems except when:
  1. All interconnected hoods within the same story,
  2. All interconnected hoods within the same room or adjoining rooms
  3. Interconnecting ducts do not penetrate assemblies required to be fire-resistance rated, and,
  4. Grease duct system does not serve solid-fuel-fired appliances

Duct Clearances: IMC §506.3.6

- When enclosure not required, Type I duct clearance:
  - ≥18" from combustible construction
  - ≥ 3" from noncombustible construction and gypsum wallboard attached to noncombustible structures
    - Exception: Listed and labeled factory built commercial kitchen grease ducts and exhaust equipment

Grease Control: IMC §506.3.7

- Duct slope:
  - No traps
  - Slope toward hood
    - ¼ unit in 12 (2%)
    - One unit in 12 (8.3%) when duct > 75 feet
- Grease duct reservoir



Clean-outs: IMC §506.3.9

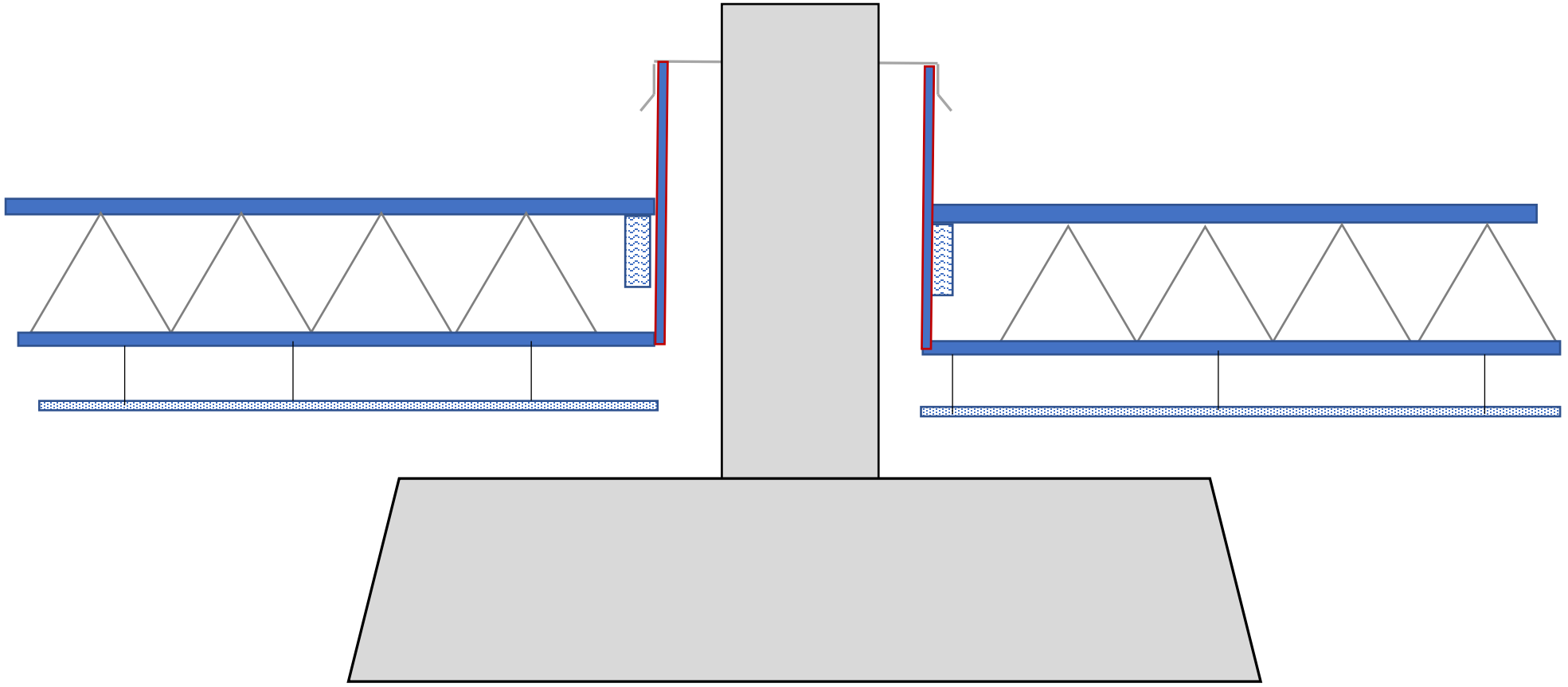
- Horizontal duct work:
  - Not more than 20 feet apart
  - Not more than 10 feet from directional changes > 45°
  - No closer than one inch to duct edge
  - At least 12 x 12 inches for access
  - Gaskets/sealants rated ≥ 1500°F

Enclosures: IMC §506.3.11

- Grease ducts serving Type I hoods that penetrate a ceiling, wall or floor:
  - Enclosed from the point of penetration to the outlet terminal
  - Exterior walls only at locations where unprotected openings are permitted by the IBC
  - Sealed around the duct at the point of penetration
  - Vented to the outside of the building through a weather-protected opening

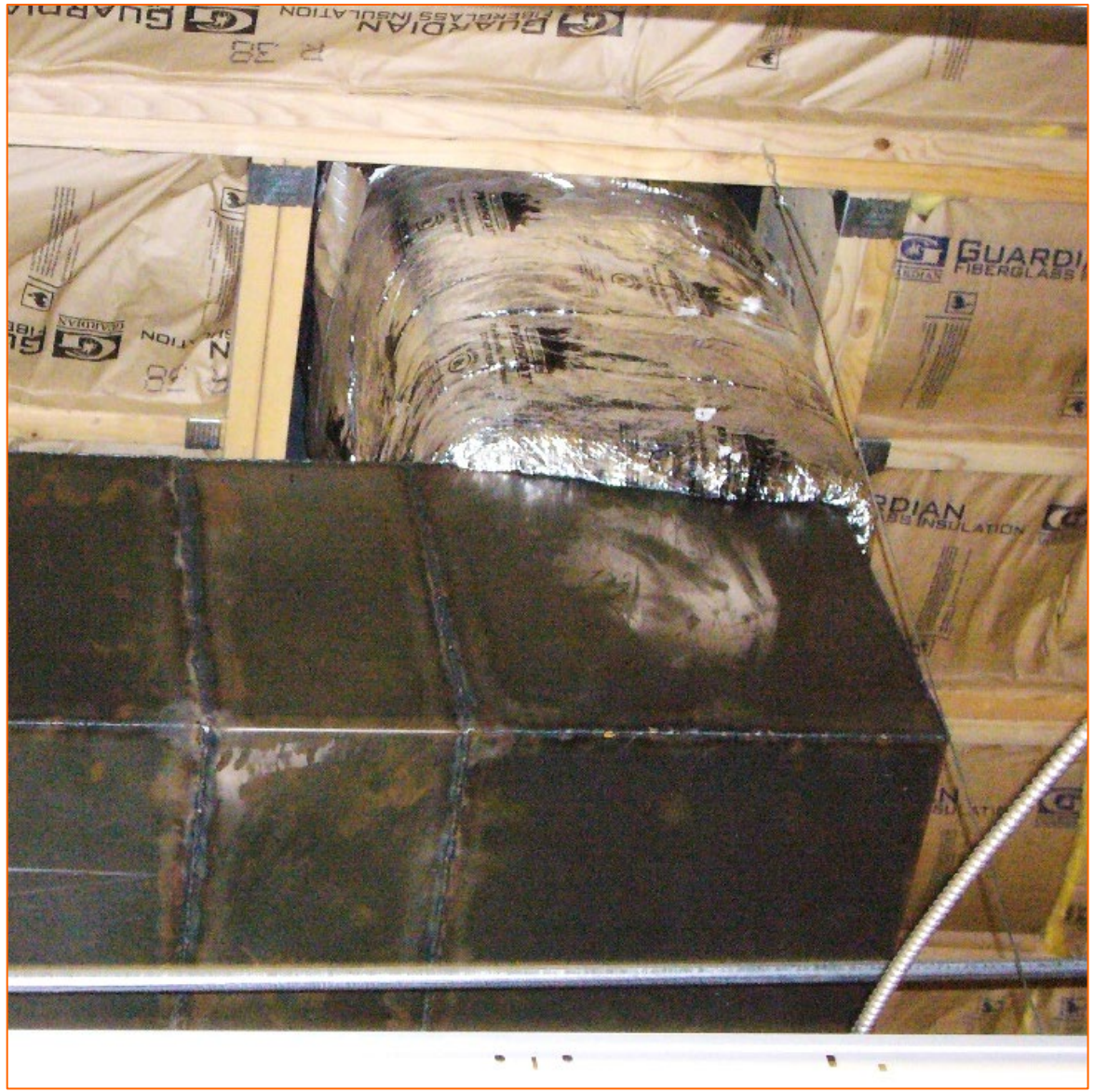
Exception: Non-rated Roof/Ceiling

- Enclosure not required for a grease duct that penetrates only a non-fire-resistance rated roof/ceiling assembly



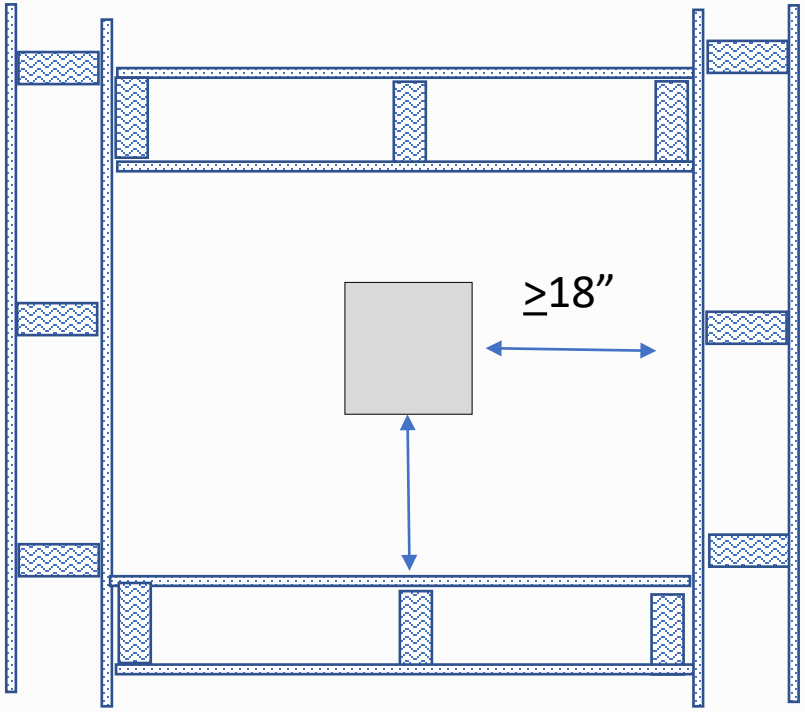
Duct Enclosure Options

- IMC §506.3.11
  - Fire-resistance-rated shaft,
  - Fire resistance-rated duct wrap
    - ASTM E 2336
    - UL 1479
    - "F" and "T" rating matching assembly
  - Factory-built enclosure assembly
    - ASTM E 814
    - UL 1479

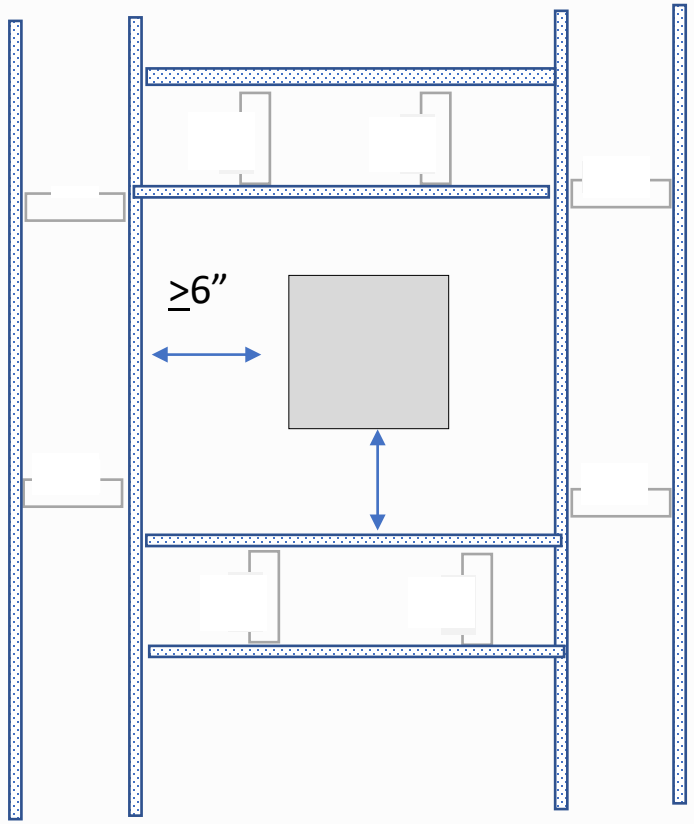


Shaft Enclosure: IMC §506.3.11.1

- ≥18”combustible construction
- ≥6” noncombustible structures



(Plan View)



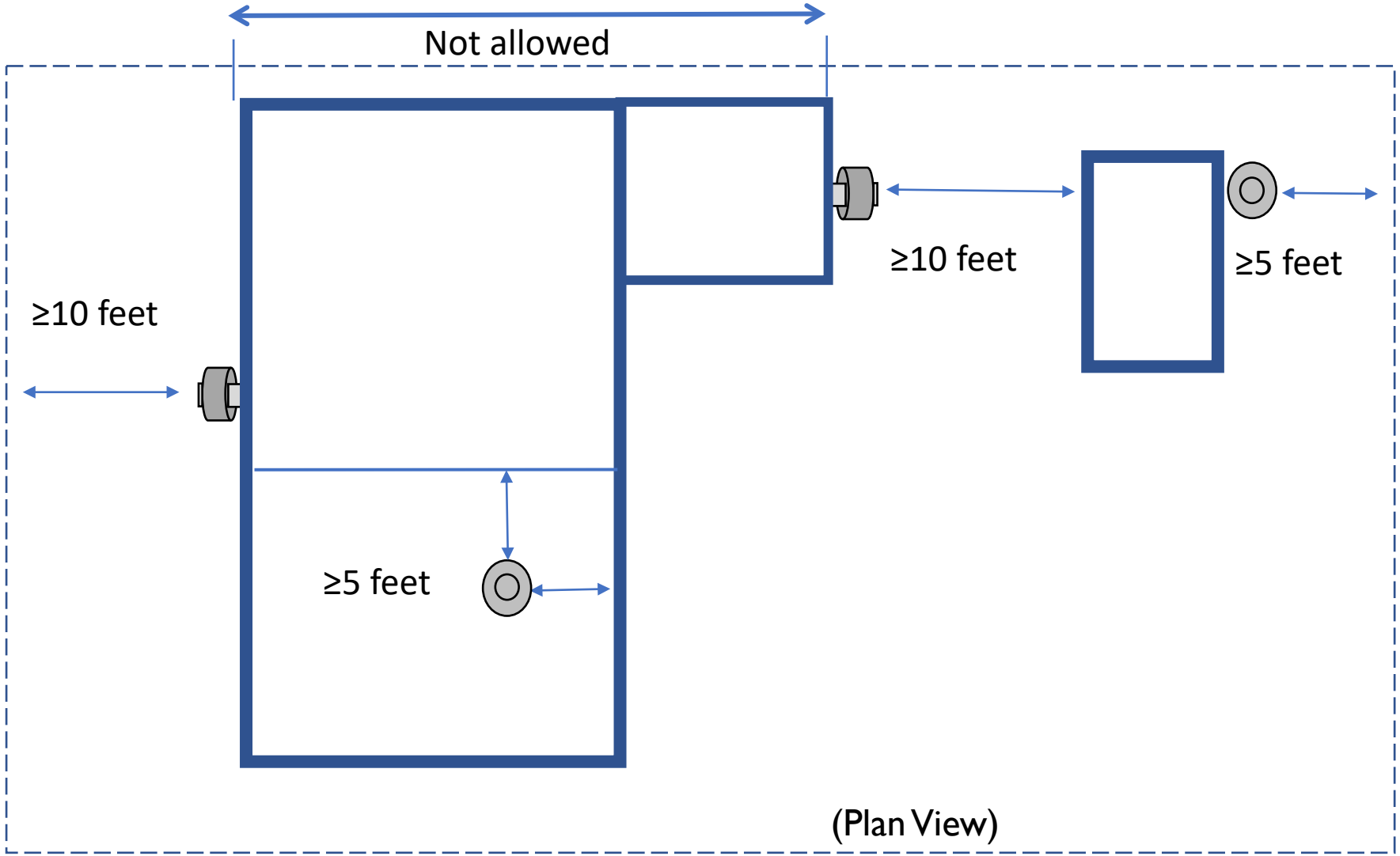
(Plan View)

Termination Point: IMC §506.3.13

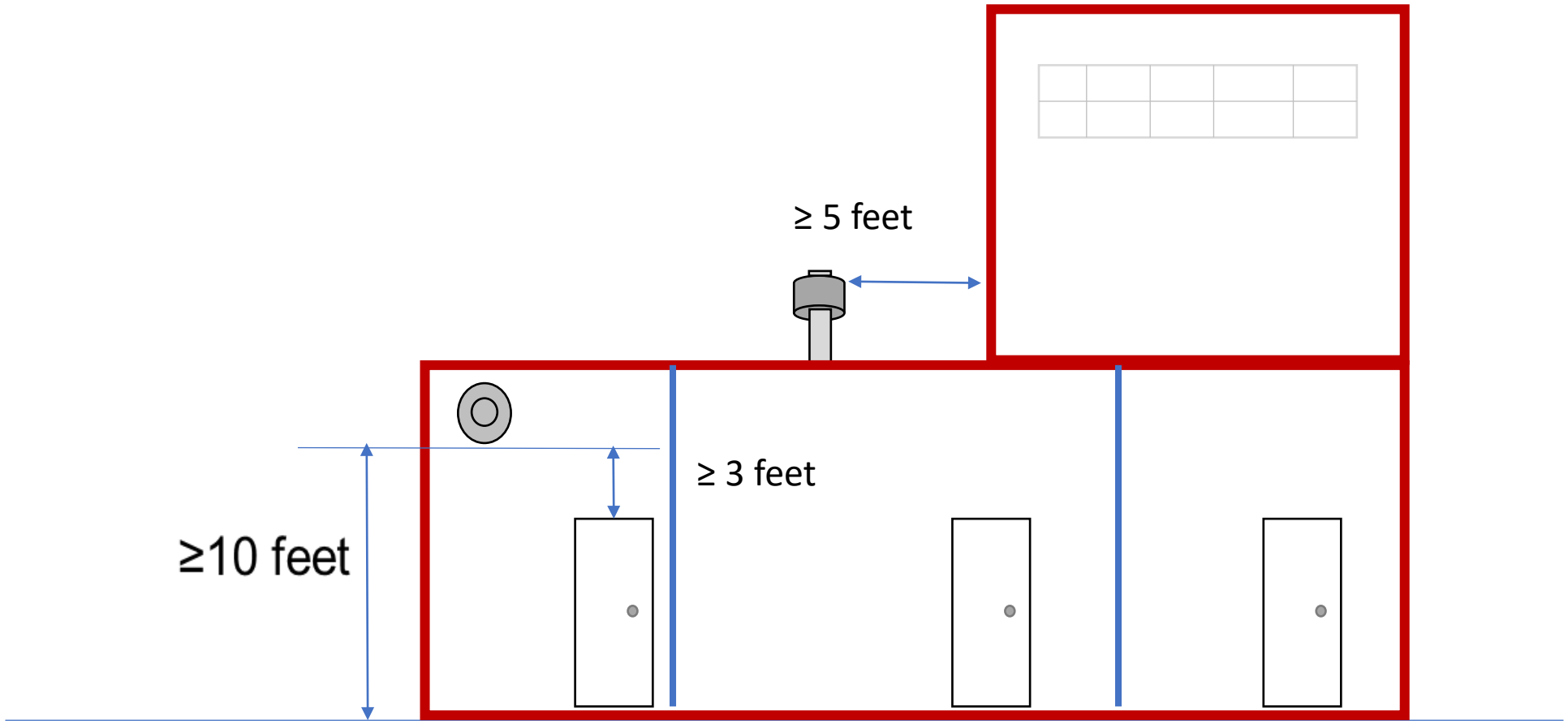
- Vertical discharge
  - At least 40 inches above roof surface

- Horizontal discharge
  - Not where protected openings required by IBC
  - No other exterior openings within three feet

Termination Point: IMC §506.3.13.3



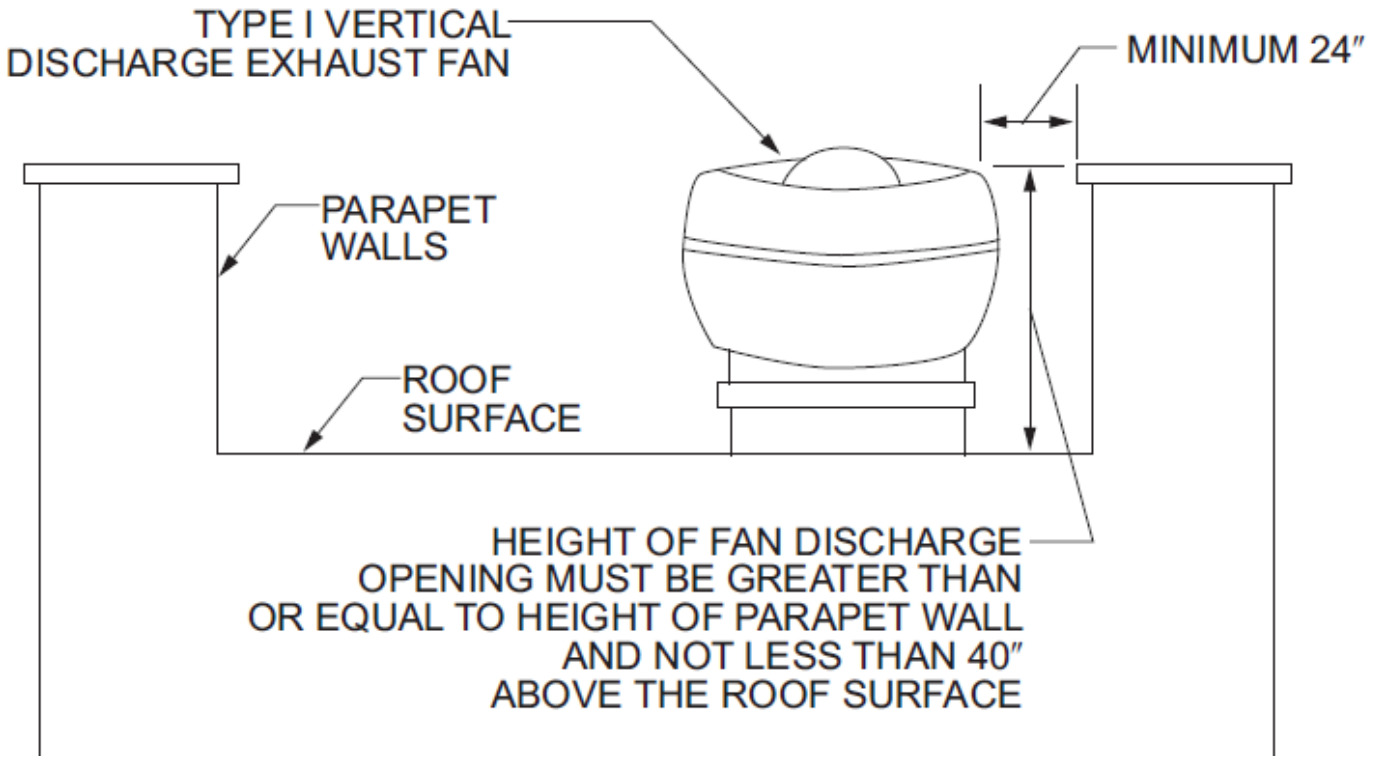
Termination Point: IMC §506.3.13.3



(Elevation View)

Exhaust Fan Mounting: §506.5.5

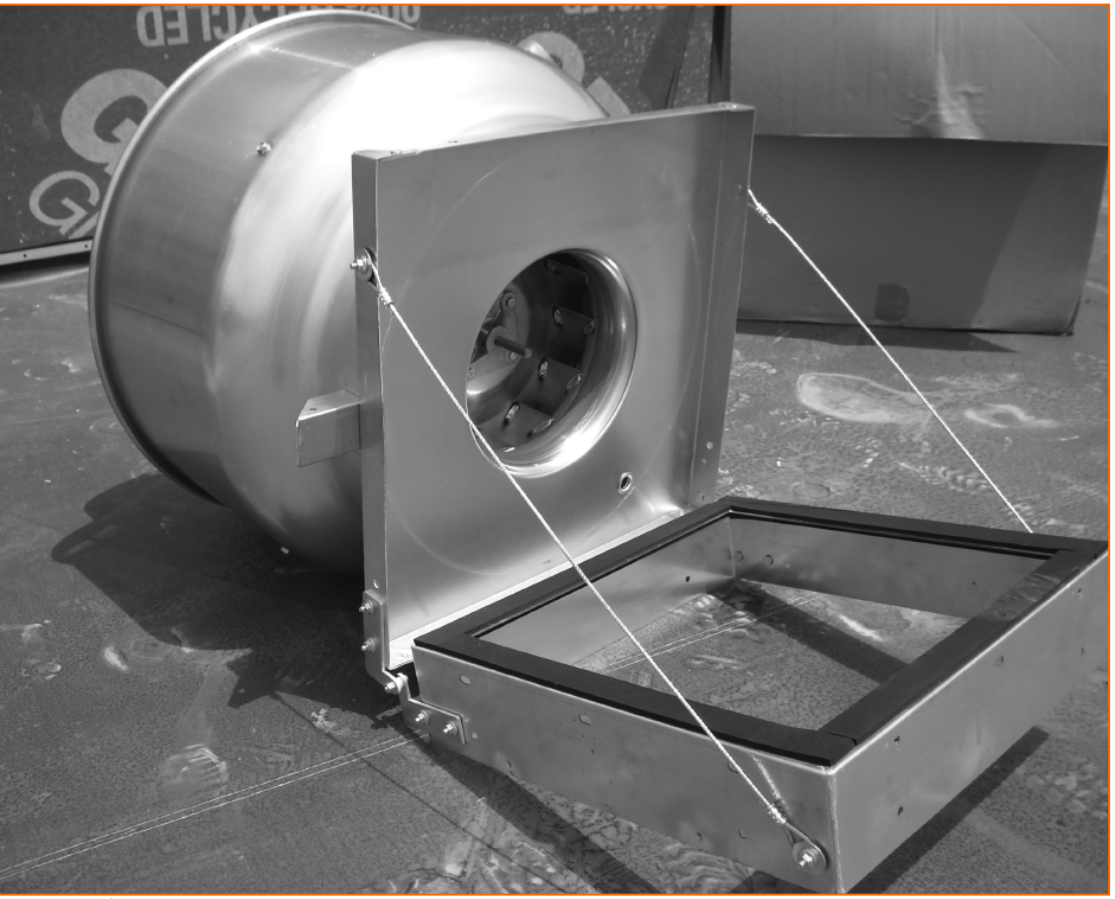
- Exception:
  - Minimum horizontal distance 24” between vertical discharge fans and parapet-type structures when parapet <u>not</u> higher than the top of the fan discharge



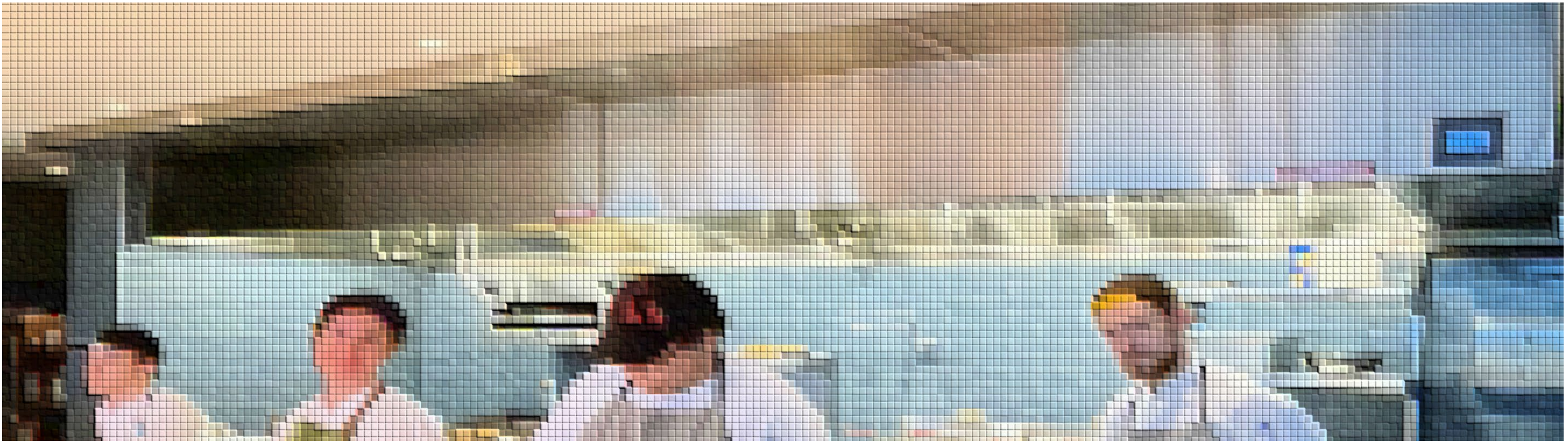
Type I Upblast: IMC §506.5.2

- Duct: ≥ 18 inches above roof
- Discharge point: ≥ 40 inches above roof
- Discharge not to impinge on:
  - roof,
  - other equipment/appliances, or,
  - parts of the structure
- Vertical discharge fan to have low point grease drain and reservoir

Exhaust Fan Mounting: §506.5.3



- Up-blast fan for inspection and cleaning:
  - Hinged, and,
  - Flexible, weatherproof electrical cable

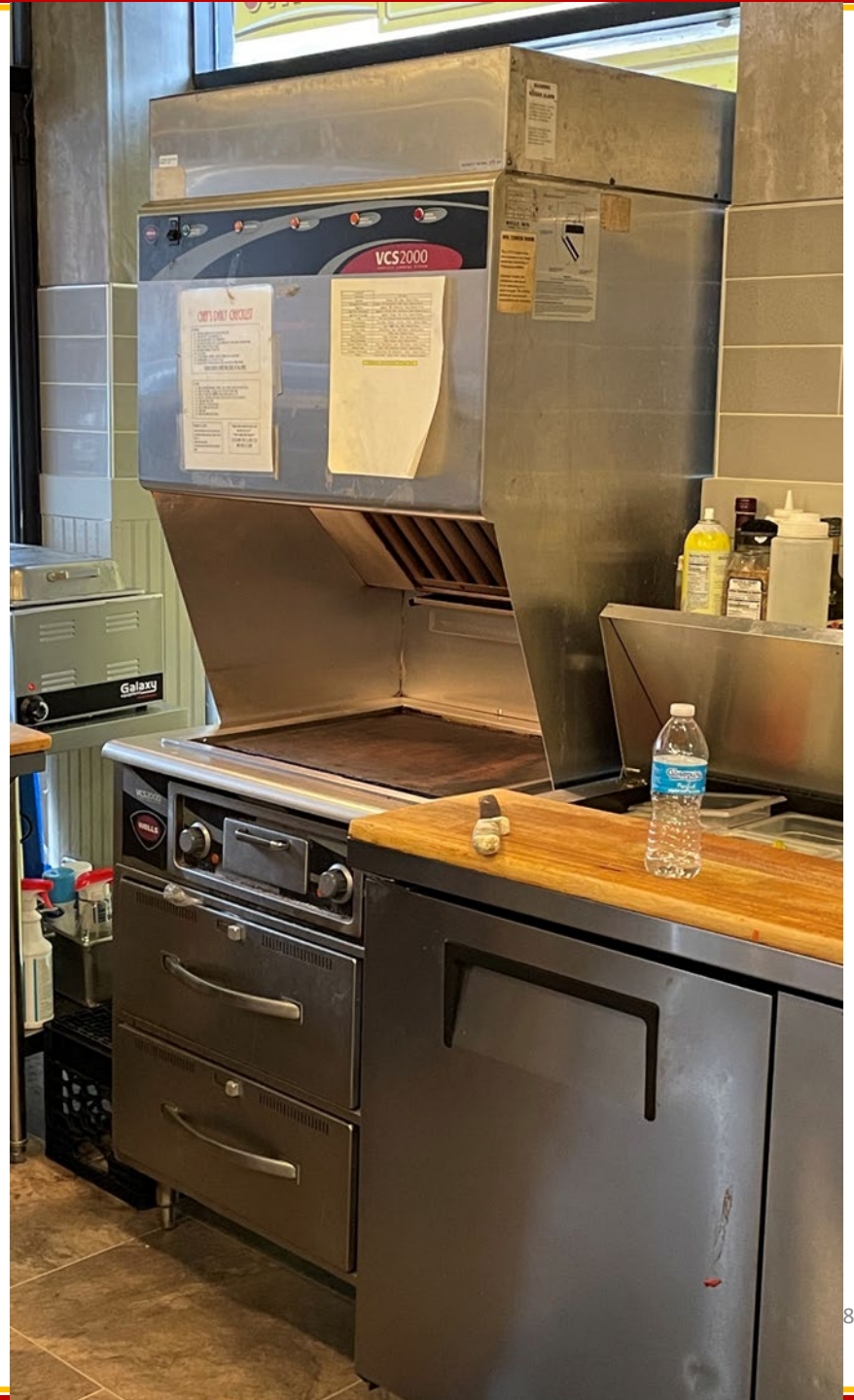


Module 5

Commercial Kitchen Hoods

Commercial Hoods IMC §507.1

- Commercial kitchen exhaust hoods:
  - Type I or Type II
    - UL 710 listed factory-built commercial exhaust hoods
    - UL 710B listed factory-built commercial cooking recirculating systems
    - Down-draft appliances listed and labeled with NFPA 96
  - Designed to capture and confine cooking vapors and residues
    - Operate during cooking



Hood Clearances: CT IMC § 506.3.6.1

Construction	Clearance (in.)
• GWB or 1/2-inch or thicker cementitious wallboard, • Attached to noncombustible structures, • Smooth, cleanable, nonabsorbent and noncombustible material installed between hood and wall, and, • Covers area extending at least18 inches in all directions from the hood.	0
• Type 1 hoods listed and labeled for clearances less than those in §507.2.6, • Meeting UL 710, and, • Installed with the listings' clearances.	3

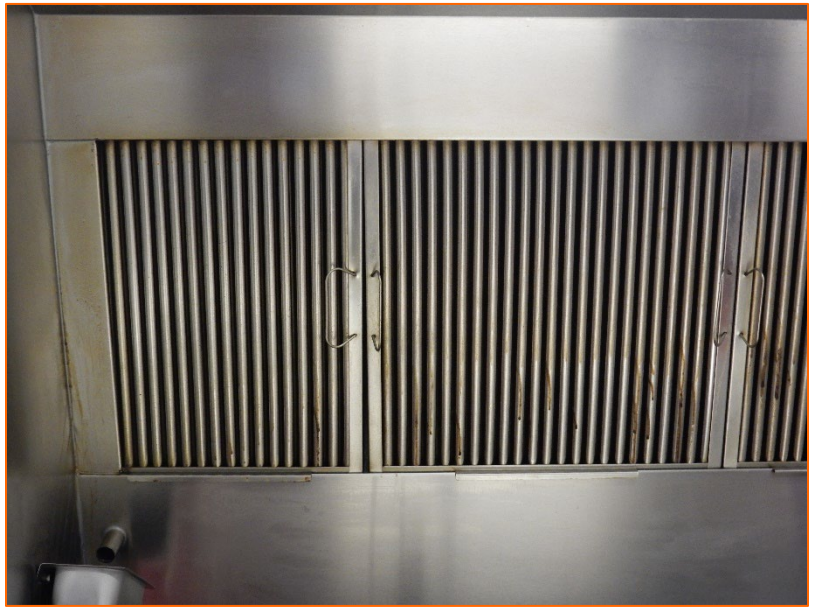
Type I Hood Details IMC §507.2

- Labeled for flow in cfm/lineal foot
  - Cooking appliance duty classification
- Materials
  - No. 18 gage steel
  - No. 20 gage stainless steel
- Non-combustible supports

Grease Filters IMC §507.2.8

- Filters listed per UL 1046
  - Installed at least 45° from horizontal
  - Drip tray beneath

Type of Cooking Appliances	Lowest Edge Above Cooking Surface (in.)
Without exposed flame	6
Exposed flame and burners	24
Exposed charcoal and charbroil type	30



Type II Hood Details: IMC §507.3

- Installed above non-grease or smoke producing appliances
  - Steam or moisture producers
- Materials
  - No. 22 gage steel
  - No. 24 gage stainless steel
- Supports adequate for loads

Ventilation Rates: IMC §507

Minimum Net Airflow for Hoods Serving Commercial Cooking Appliances

(cfm per linear foot of hood)

Hood Type	Extra-heavy-duty Type I Only	Heavy-duty Type I Only	Medium-duty Type I Only	Light-duty Type I or Type II
Backshelf/pass-over	Not allowed	400	300	250
Double island canopy	550	400	300	250
Eyebrow	Not allowed	Not allowed	250	250
Single island canopy	700	600	500	400
Wall-mounted canopy	550	400	300	200

Makeup Air IMC §508.1.1

- Makeup air to be supplied during the operation of commercial kitchen exhaust systems
  - For mechanical makeup air systems, the exhaust and makeup air systems shall be electrically interlocked
- Temperature differential between makeup air and the conditioned space not to exceed 10°F

Air Balance Plan IMC §508.1.2

- Produced at design phase:
  - Show design outdoor air balance
    - Exhaust/replacement
    - Net air leakage, if any
  - Total make-up air must equal exhaust flow plus leakage

AIR BALANCE SCHEDULE		
UNIT	EXHAUST	INTAKE
DOAS-1	---	2,425 CFM
DOAS-2	---	1,150 CFM
KEF1	1,800 CFM	---
KEF2	575 CFM	---
KEF3	650 CFM	---
EF1	250 CFM	---
TOTAL	3,275 CFM	+300 CFM
NOTE: DOAS UNITS TO BE INTERLOCKED WITH HOOD OPERATION.		

Fire Suppression IMC §509.1

- Fire suppression system required for Type I hood and duct systems
  - Refer to IBC and IFC

Module 6

IFC Requirements

Kitchen Hoods: IFC §609

- Type I for commercial operations
- Operational requirements
  - Ventilation system operated at required air flow
  - Grease extraction devices in place
  - Inspection frequency and cleaning
    - Records maintenance
    - Cleaning tags

IFC §609.2 Exception

- Type I hood not required for:
  - Electric cooking appliance
    - e.g., Steam table, rice cooker
  - Documented effluent 5 mg/m^3 or less at 500 cfm
  - Tested per UL 710B "Recirculating Systems"
- Aligns IFC with IMC
- Fire suppression system not required

Courtesy: VEVOR

Fire Extinguishing: IFC §904.12

- Must meet UL 300 *Commercial Cooking Protection*
  - Exception for
    - UL 710B listed and labeled "recirculating" cooking systems
    - Sprinklers
- Equipment must be listed and labeled
- Cooking equipment fuel/electrical shut down

Fire Extinguishing: IFC §904.12

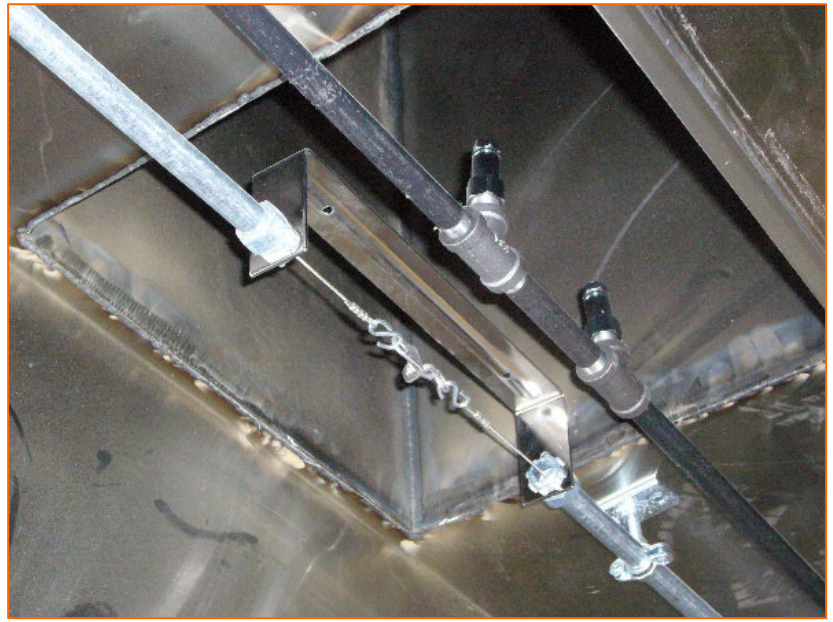
- Systems installed in accordance with the referenced standard indicated:
  - NFPA 12, Carbon Dioxide
  - NFPA 13, Automatic Sprinkler Systems
  - NFPA 16, Foam-water Sprinkler System or Foam-water Spray Systems
  - NFPA 17, Dry-chemical
  - NFPA 17A, Wet-chemical

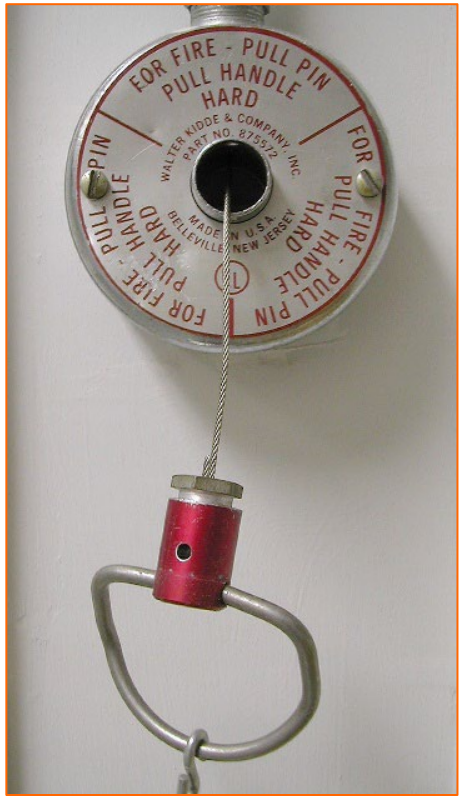
Tyco EA-1

Courtesy: Tyco Building Products

System Activation: IFC §904.12

- Activation must be available by automatic and manual means
  - Except automatic sprinklers





System Activation: IFC §904.12

- Fuel gas and/or electrical power interlock to shut down all appliances

Portable Equipment: IFC §904.12.5

- Portables required
- Listed Type K extinguisher
  - Travel distance to the extinguisher ≤30’
  - For solid fuel cooking
    - One 2.5-gallon or two 1.5-gallon portables

Photo courtesy of Amerex

Portable Equipment: IFC §904.12.5

Fryers	Max. Cooking Medium Capacity (Each Fryer)	Class K Extinguishers
Group of 4	80	1 each 1.5 gallon
Each additional group of 4	80	1 additional 1.5 gallon
Individual fryers > 6 ft^2 surface	--	See manufacturer's recommendations

Maintenance: IFC §904.12

- Fire suppression system adjusted when:
  - Cooking media changes,
  - Cooking equipment re-positioned, or,
  - Cooking equipment replacement.
- Serviced by qualified individuals
  - Every 6 months, and,
  - After activation.
- Fusible links and sprinklers replaced annually.

Group I-2, Condition 1: IFC §904.13

- See IBC §407.2.6
  - Nursing and foster care
- Domestic-type hood
  - Extinguishing system for residential range
  - UL 300A
    - Automatic and manual operation
    - Fuel/energy shutdown interconnection

Courtesy: Kitchen Fire Stop

Module 7

System Inspection, Testing and Maintenance

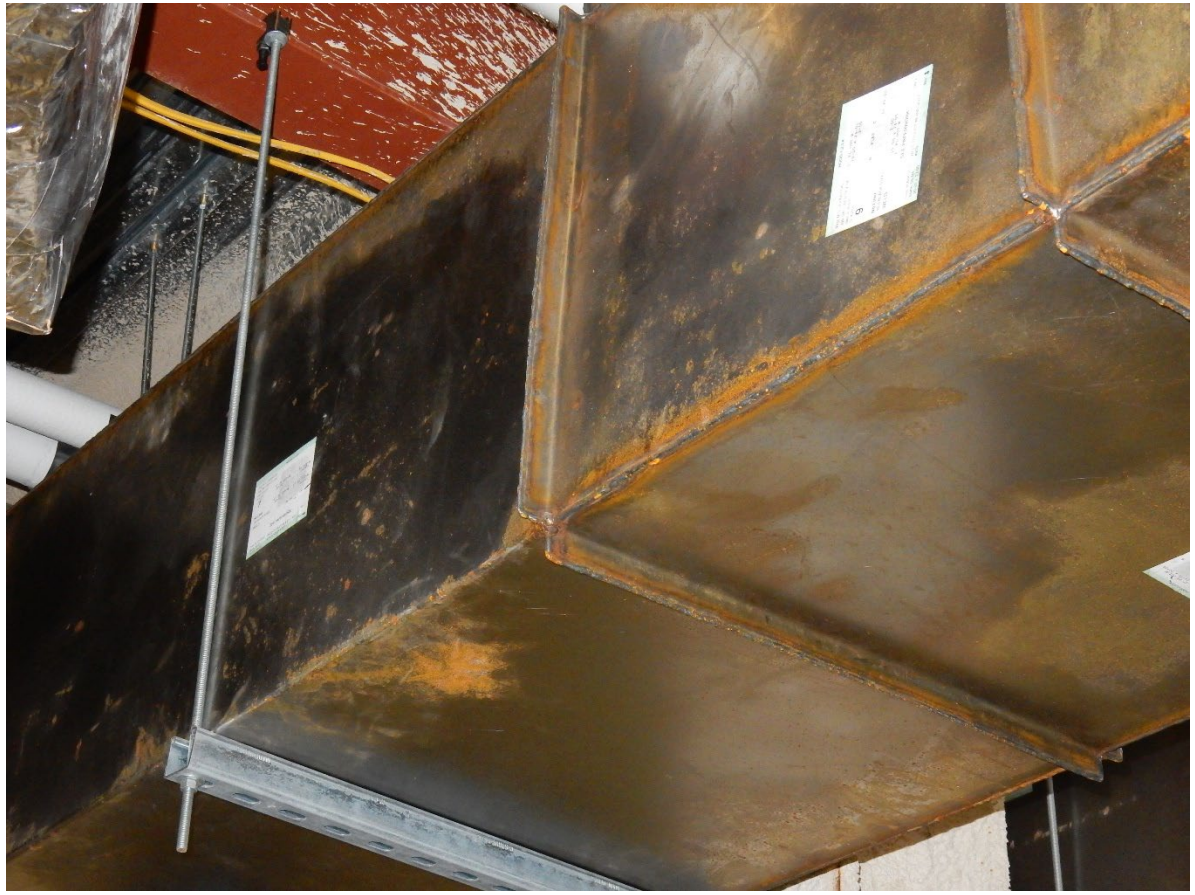
Duct Leakage Tests: IMC §506.3.2.5.1

- Prior to use or concealment of any portion of a grease duct system
  - "Concealed:" in shafts or covered by coatings or wraps that prevent all-side inspection.
  - All connections, seams and welds visible during the test.
  - May be tested in sections if every joint is tested.
- Test entire duct system, including the hood-to-duct connection.
- For listed factory-built grease ducts, test limited to field-assembled and excludes factory welds.

Duct Leakage Test: Light Test

- Minimum 100-watt light dragged through tested portion

PASS: No light leakage.



Duct Leakage Tests: Alternate Method 1

§506.3.2.5.1 Positive pressure smoke test

1. Seal entire duct system from hood exhaust opening(s) to duct termination.
2. Introduce visible smoke into to the duct system.
3. Pressurize sealed duct to at least 1.0-inch water column (about 1/28 psi).
    - Do not exceed system and components positive pressure capability.

PASS: No smoke from any exterior surface of the duct.

Duct Leakage Tests: Alternate Method 2

§506.3.2.5.2 Air test

1. Seal entire duct system from the hood exhaust opening(s) to duct termination.
2. Pressurize duct system to a minimum pressure of 1.0-inch water column

PASS: Hold initial set pressure for a minimum of 20 minutes.

Duct Leakage Tests: Alternate Method 3

§506.3.2.5.3 Water test

1. Use a pressure washer operating at a minimum of 1500 psi simulating cleaning operations.
2. Apply water directly to all areas to be tested.

PASS: No water applied to the duct interior shall be visible on any exterior surface in any volume during the test.

Hood Performance Test: IMC §507.6

- Conducted before ventilation system final approval
- Test verifies
  - Exhaust airflow
  - Makeup airflow
  - Proper operation
- Permit holder provides test equipment and devices required to perform the tests

Capture/Containment Tests: IMC §507.6.1

- Verify capture and containment exhaust performance.
- Conducted with:
  - All appliances under the hood at operating temperatures,
  - All sources of outdoor air providing makeup air for the hood operating, and,
  - All sources of re-circulated air providing conditioning for the space in which the hood is located operating.
- Capture and containment shall be verified visually by observing simulated smoke or steam.

Hood Makeup Air IMC §508.1.1

- Makeup air to be supplied during the operation of commercial kitchen exhaust systems
  - For mechanical makeup air systems, the exhaust and makeup air systems shall be electrically interlocked
- Temperature differential between makeup air and the conditioned space not to exceed 10°F

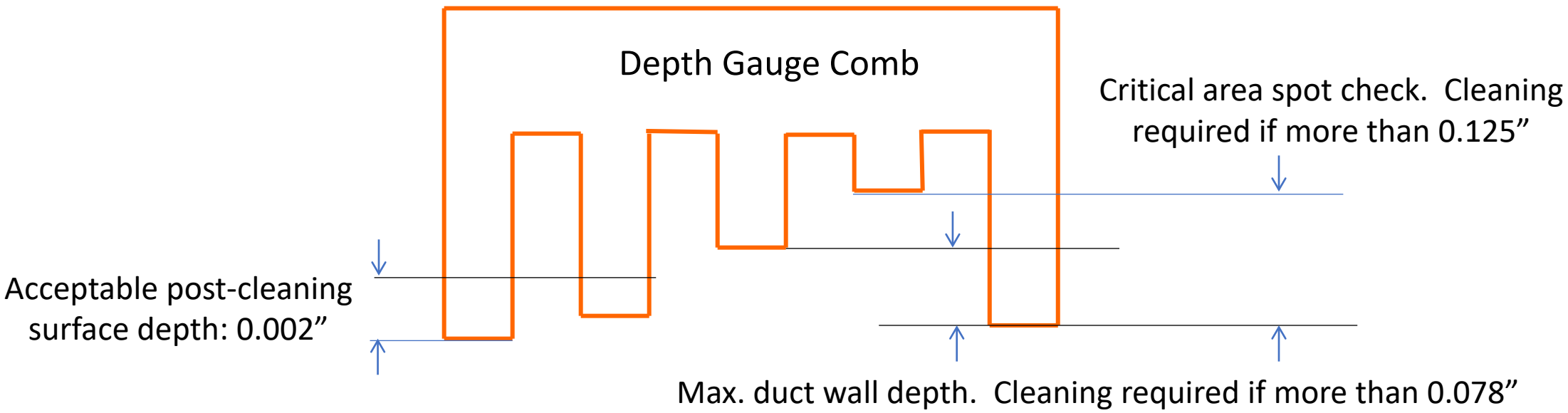
Courtesy: GOWE

System Inspections: IFC §609.3.3.1

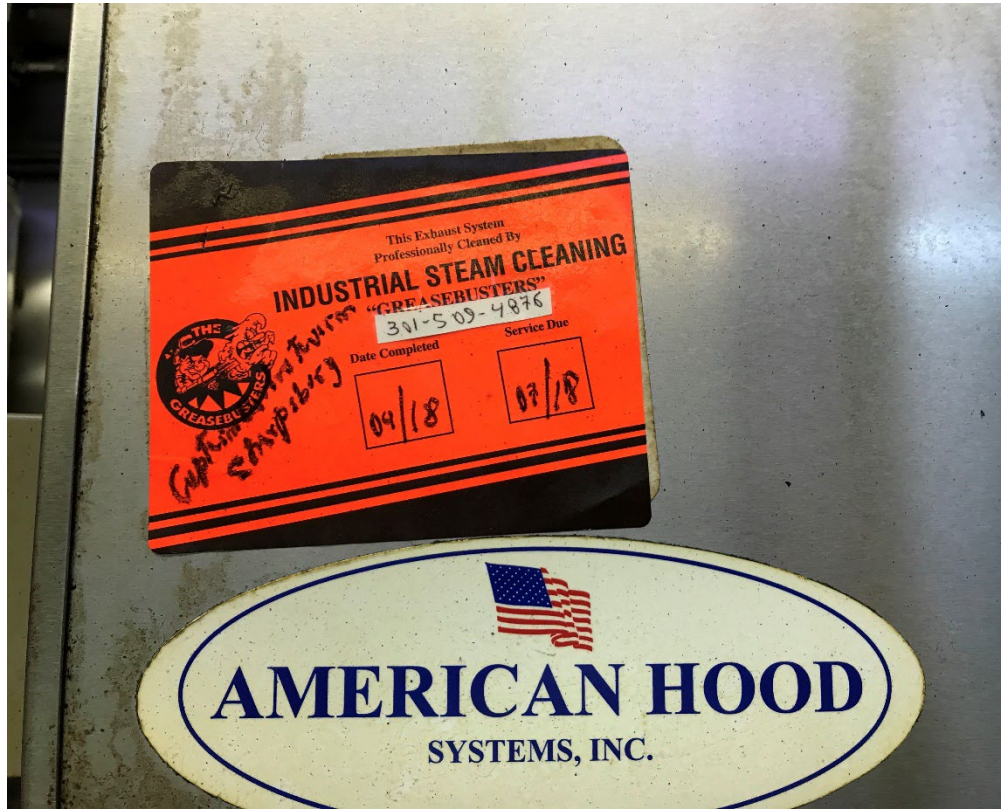
Cooking Operations	Examples	Inspection Frequency
Solid fuel-burning cooking appliances	Charcoal or wood-fired grilles, wood- or coal-fired pizza ovens	1 month
High-volume	24-hour cooking, charbroiling or wok cooking	3 months
Low-volume	Places of religious worship, seasonal businesses and senior centers	12 months
All other	Restaurants, diners, schools, hospitals, etc.	6 months

Cleaning Standard

- International Kitchen Exhaust Cleaning Association
  - C10-2011 "Cleaning Commercial Exhaust Systems"



Service Tag: IFC §609.3.3.3



Review

- Define commercial cooking terms and hazards
- Identify code requirements for commercial cooking exhaust systems
- Describe Type I hood and grease exhaust duct acceptance tests.
- Identify requirements for commercial cooking fire suppression systems and equipment

A Final Look

Questions or Comments?

Please complete the end-of-course evaluation. Thank you.

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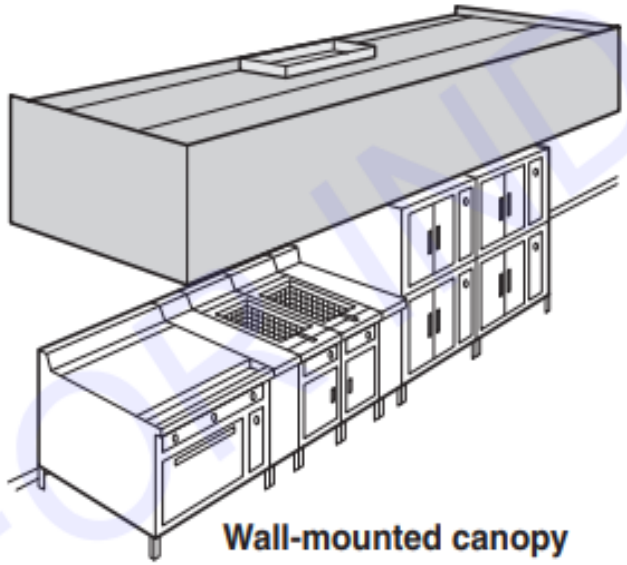
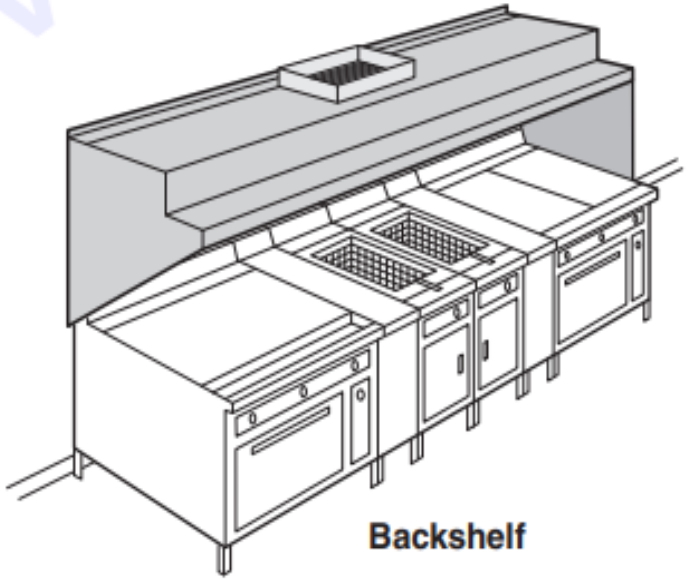
Back-Up Slides

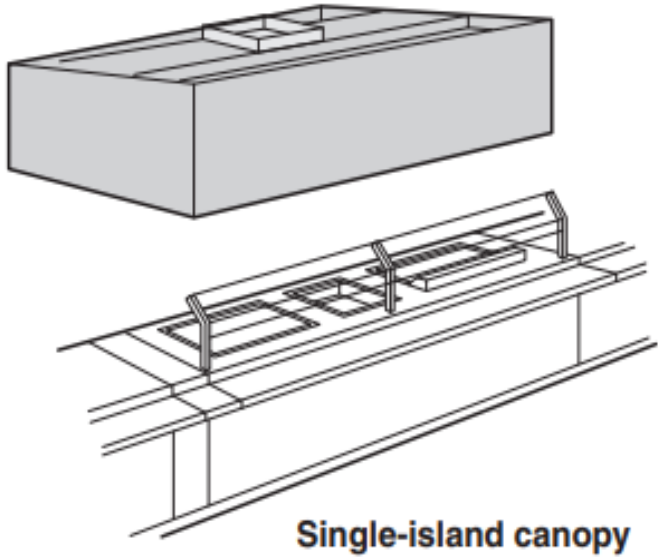
Supplemental Information



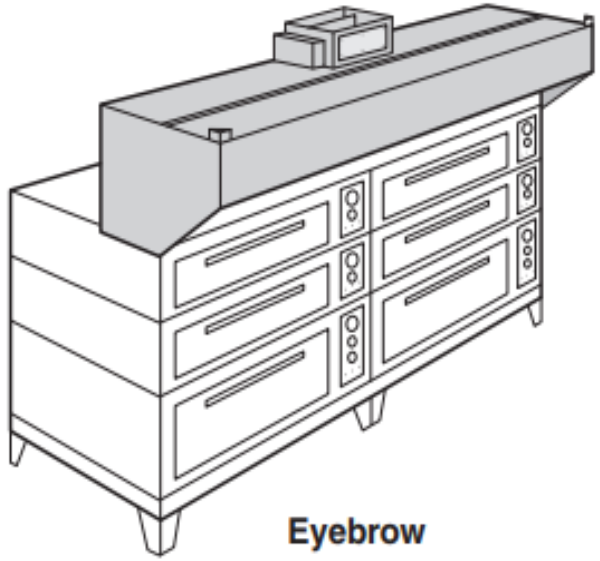
Wall-mounted canopy



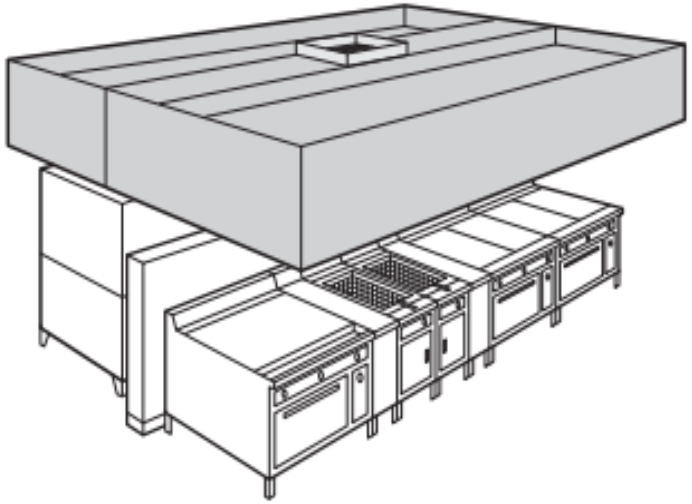
Backshelf



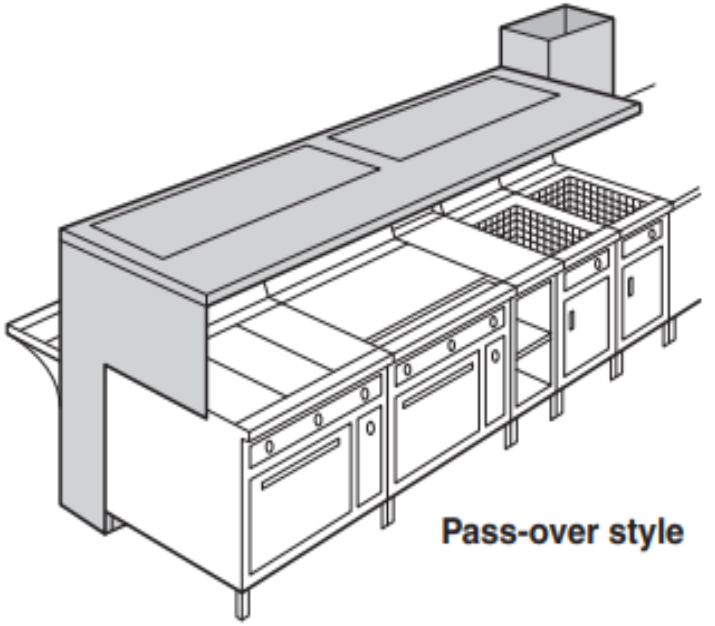
Single-island canopy



Eyebrow



Double-island canopy



Pass-over style

Courtesy: National Fire Protection Association©, NFPA© 96

IMC §308: Clearance Reduction Methods

TABLE 308.4.2
CLEARANCE REDUCTION METHODS[b]

TYPE OF PROTECTIVE ASSEMBLY[a]	REDUCED CLEARANCE WITH PROTECTION (inches)[a]							
	Horizontal combustible assemblies located above the heat source				Horizontal combustible assemblies located beneath the heat source and all vertical combustible assemblies			
	Required clearance to combustibles without protection (inches)[a]				Required clearance to combustibles without protection (inches)			
	36	18	9	6	36	18	9	6
Galvanized sheet steel, having a minimum thickness of 0.0236 inch (No. 24 gage), mounted on 1-inch glass fiber or mineral wool batt reinforced with wire on the back, 1 inch off the combustible assembly	18	9	5	3	12	6	3	3
Galvanized sheet steel, having a minimum thickness of 0.0236 inch (No. 24 gage), spaced 1 inch off the combustible assembly	18	9	5	3	12	6	3	2
Two layers of galvanized sheet steel, having a minimum thickness of 0.0236 inch (No. 24 gage), having a 1-inch airspace between layers, spaced 1 inch off the combustible assembly	18	9	5	3	12	6	3	3
Two layers of galvanized sheet steel, having a minimum thickness of 0.0236 inch (No. 24 gage), having 1 inch of fiberglass insulation between layers, spaced 1 inch off the combustible assembly	18	9	5	3	12	6	3	3
0.5-inch inorganic insulating board, over 1 inch of fiberglass or mineral wool batt, against the combustible assembly	24	12	6	4	18	9	5	3
3½-inch brick wall, spaced 1 inch off the combustible wall	—	—	—	—	12	6	6	6
3½-inch brick wall, against the combustible wall	—	—	—	—	24	12	6	5

For SI: 1 inch = 25.4 mm, °C = [(°F) – 32]/1.8, 1 pound per cubic foot = 16.02 kg/m³, 1.0 Btu • in/(ft² • h • °F) = 0.144 W/m² • K.

a. Mineral wool and glass fiber batts (blanket or board) shall have a minimum density of 8 pounds per cubic foot and a minimum melting point of 1,500°F. Insulation material utilized as part of a clearance reduction system shall have a thermal conductivity of 1.0 Btu • in/(ft² • h • °F) or less. Insulation board shall be formed of noncombustible material.

b. For limitations on clearance reduction for solid fuel-burning appliances, masonry chimneys, connector pass-throughs, masonry fire places and kitchen ducts, see Sections 308.4.2.1 through 308.4.2.5.

Appliance Categories: Extra Heavy Duty

Category	Examples
Extra – Heavy Duty	Appliances using solid fuel as the primary heat
	Wood, charcoal, briquettes and mesquite

Appliance Categories: Heavy Duty

Category	Examples
Heavy Duty	Gas under-fired broilers
	Gas chain (conveyor) broilers
	Gas open-burner ranges (With or without oven)
	Electric and gas wok ranges
	Electric and gas over-fired (upright) broilers and salamanders
	Electric under-fired broilers
	Electric chain (conveyor) broilers

Appliance Categories: Medium Duty

Category	Examples
Medium Duty	Electric discrete element & hot top ranges
	Electric and gas griddles
	Electric and gas double sided griddles
	Electric and gas fryers
	Electric and gas pasta cookers
	Electric and gas conveyor pizza ovens
	Electric and gas tilting skillets (braising pans)
	Electric and gas rotisseries

Appliance Categories: Light Duty

Category	Examples
Light Duty	Electric and gas ovens
	Electric and gas steam-jacketed kettles
	Electric and gas compartment steamers
	Electric and gas cheese-melters

“F” and “T” Ratings – IBC §202

- F Rating
  - Time period a *through-penetration fire stop system* or *perimeter containment system* limits the fire spread through a penetration or void.

- T Rating
  - Time period a *through-penetration fire stop system*, including the penetrating item, limits the maximum temperature rise to 325°F above its initial temperature through the penetration on the nonfire side when tested to ASTM E814 or UL 1479.