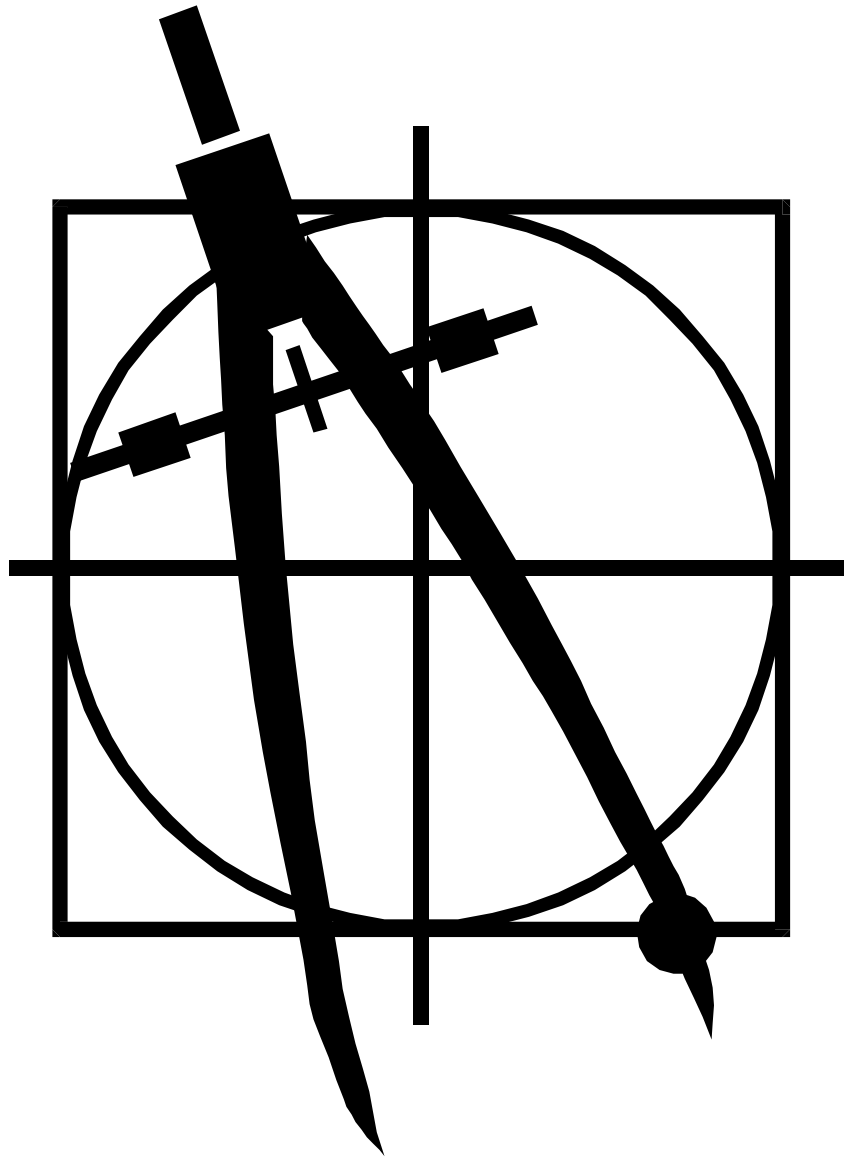


# ***MECHANICAL EXHAUST VENTILATION SYSTEMS FOR RETAIL FOOD FACILITIES***

## **Design, Calculations, and Operational Guidelines**



California Conference of Directors of Environmental Health

January 22, 2019

## **TABLE OF CONTENTS**

I.	Background.....	3
II.	Purpose and Scope.....	3
III.	Legal Authority and Applicable Codes and Standards.....	3
IV.	Definitions.....	3
V.	General Requirements.....	5
VI.	Type I Hoods.....	7
	A. Unlisted Type I Hoods (Custom).....	7
	a. Extra Heavy Duty Cooking Appliances (Table 1).....	7
	b. Heavy Duty Cooking Appliances (Table 2).....	7
	c. Medium Duty Cooking Appliances (Table 3).....	8
	d. Light Duty Cooking Appliances (Table 4).....	8
	B. Listed Hoods (UL 710).....	8
	C. Recirculating Systems (UL 710B).....	8
	D. Cooking Appliances with Reduced Grease Emissions (EPA 202 Test).....	8
	E. Downdraft Appliances.....	9
VII.	Type II Hoods.....	9
	A. Unlisted Type II Hoods (Custom).....	9
	B. Listed Type II Hoods (UL 710).....	10
	C. Dishwashing Machines with Self-Contained Condensing System (UL 921).....	10
VIII.	Recommended Formulas for Specific Equipment.....	10
IX.	Grease Filters.....	13
X.	Exhaust Hood Ducting.....	15
XI.	Exhaust Hood Installation Requirements.....	17
XII.	Eye-brow-Type Exhaust Hoods.....	17
XIII.	Noncanopy-Type Exhaust Hoods.....	18
XIV.	Water Wash-Type Exhaust Hoods.....	18
XV.	Make-Up Air.....	19
XVI.	Fire Extinguishing Systems.....	19
	APPENDIX I (Resources, Codes, Standards).....	21
	FIGURES 1-7.....	23

# **MECHANICAL EXHAUST VENTILATION SYSTEMS FOR RETAIL FOOD FACILITIES**

## **Design, Calculations, and Operational Guidelines**

California Conference of Directors of Environmental Health

### **I. Background**

Proper venting and capture of the gases, heat, grease, vapors, and smoke generated by cooking equipment is important; not only for fire prevention and sanitation purposes, but also for maintaining the health and well being of food service workers. In order to help prevent dangerous or unhealthful conditions within a food facility, it is critical that exhaust ventilation systems be designed, constructed, and operated in compliance with all applicable requirements.

### **II. Purpose and Scope**

- A. These guidelines are intended to assist in determining mechanical exhaust ventilation requirements for equipment that generates grease, vapors, fumes, smoke, steam, heat, and/or odors.
- B. Exhaust ventilation systems shall also conform to all local building and fire codes and have all necessary approvals from the local building and fire authorities.
- C. The requirements contained within this document represent minimum standards, which may be superseded by local ordinances. Where there is a contradiction in the requirements, the stricter should apply.
- D. Due to the differing roles of the local enforcement agencies and local building departments, not all health jurisdictions will be applying all portions of these guidelines.

### **III. Legal Authority and Applicable Codes and Standards**

- A. California Health and Safety Code, Division 104, Part 7, Chapter 6, Article 2, Section 114149 – 114149.3 (California Retail Food Code, Cal Code).
- B. California Code of Regulations, Title 17, Article 10.4, Commencing with Section 13670.
- C. California Code of Regulations, Title 24, Part 4, Chapter 5, Part II (California Mechanical Code, CMC).

### **IV. Definitions**

- A. *Backshelf (Noncanopy hood)* - a hood that does not extend completely over the cooking equipment. A noncanopy hood is designed to be as close as possible to the cooking surface. This type of hood may also be referred to as a low proximity hood.
- B. *Canopy Hood* – a hood designed so the inside edge overhangs or extends a

horizontal distance not less than six inches beyond the outer edges of the cooking surface.

- C. *Compensating Hood* – A hood that has an outside air-supply with air delivered below or within the hood. Where makeup air is diffused directly into the exhaust within the hood cavity, it becomes a short-circuit hood. This design shall provide no more than 10% of the exhaust airflow, typically through four basic discharge methods: short-circuit, face-discharge, back-discharge, and down-discharge. These methods may also be combined, such as a face and down- discharge arrangement. Short-circuiting hoods shall be tested and listed by a qualified testing agency and installed/operated according to the listing conditions.
- D. *Convection Oven* – a gas or electric heated oven that uses a fan or blower to recirculate the heat throughout the interior of the oven.
- E. *Double Island Canopy* – two single island hoods installed back to back.
- F. *Downdraft Appliance* – an appliance with an integral exhaust ventilation system that exhausts cooking fumes across the cooking surface downward. This type of cooking appliance is typically used for front of house cooking applications such as hibachi style tables.
- G. *Ducting* – the conduit that is used to convey exhausted air from the exhaust hood to the outside of the food facility.
- H. *Eyeblink Hood*- An eyebrow hood is mounted directly to the face of an appliance, such as an oven and dishwasher, above the opening(s) or door(s) from which effluent is emitted, extending past the sides and overhanging the front of the opening to capture the effluent.
- I. *Grease Extractor* – a series of baffles installed in the exhaust hood in such a way as to remove grease from the exhausted air using centrifugal force.
- J. *Grease Filter* – a device that is installed in the exhaust hood in such a way as to remove grease from the exhausted air by entrapment, impingement, adhesion, or other similar means.
- K. *Hood* – an air-intake device connected to a mechanical exhaust ventilation system for collecting and removing cooking effluent which contains grease, vapors, fumes, smoke, steam, heat, or odors which are generated by cooking equipment and warewashing machines.
- L. *Listed Equipment* – equipment and materials which, following evaluation and acceptance by a qualified testing agency, are placed on a list of certification. The listing shows that the equipment and materials comply with accepted national standards, which have been approved or evaluated for conformity with approved, or national standards.
- M. *Pass-over Hood*- A pass-over hood is a free-standing form of a backshelf hood constructed low enough to pass food over the top.
- N. *Plenum* – an air compartment or chamber to which one or more ducts are connected and which forms part of the supply-air, return-air, or exhaust air system.
- O. *Portable* – equipment having the properties of being portable, weighing less than 80 pounds, not exceeding three feet in any plane, and having utility connections designed to be disconnected or of sufficient length to permit equipment movement for cleaning.

- P. *Recirculating Hood System (Ductless hoods or Ventless hoods)* – a self-contained air exhaust system that removes grease, vapors, fumes, smoke, steam, and odors from the exhausted air; and then reintroduces the filtered air back into the food facility. The grease, vapors, fumes, smoke, and steam are normally removed using a variety of systems such as water sprays, electrostatic precipitators, or multiple filter banks. The odors are typically removed using activated charcoal filters. Recirculating hood systems are not designed to eliminate heat from the exhausted air. Recirculating hood systems are also known as ductless or ventless hoods. These systems are certified under UL product categories KNKG (Commercial cooking appliances with integral recirculating ventilation systems) or YZCT (Hoods/recirculating systems for use with specified commercial cooking appliances).
- Q. *Single Island Canopy* – a canopy hood that is mounted from the ceiling with all four sides exposed. This installation can allow for display cooking.
- R. *Type I Exhaust Hood* – a hood that is designed to collect and remove all types of cooking effluent from the exhausted air.
- S. *Type II Exhaust Hood* – a hood that is designed to collect and remove **only** steam, vapors, heat, or odors.
- T. *Water-Wash-Type Exhaust Hood* – a Type I hood which uses water to remove accumulated grease from the grease extractors.

## V. **General Requirements**

- A. Cal Code requires the following:
  - 1. Section 114149(a) “All areas of a food facility shall have sufficient ventilation to facilitate proper food storage and to provide a reasonable condition of comfort for each employee, consistent with the job performed by the employee.”
  - 2. Section 114149.1(a) “Mechanical exhaust ventilation equipment shall be provided over all cooking equipment as required to effectively remove cooking odors, smoke, steam, grease, heat, and vapors. All mechanical exhaust ventilation equipment shall be installed and maintained in accordance with the California Mechanical Code, except that for units subject to Part 2 (commencing with Section 18000) of Division 13, an alternative code adopted pursuant to Section 18028 shall govern the construction standards.”
- B. C M C Section 508.1 states:
  - 1. “**Type I** hoods shall be installed at or above commercial-type deep-fat fryers, broilers, grills, hot-top ranges, ovens, barbecues, rotisseries, and similar equipment that emits comparable amounts of smoke or grease in a food-processing establishment. For the purpose of this section, a food-processing establishment shall include a building or portion thereof used for the processing of food, but shall not include a dwelling unit.”
  - 2. “**Type II** hoods shall be installed above equipment and dishwashers that generate steam, heat, and products of combustion, and where grease or smoke is not present.”

- C. **Type I Hood Requirement:** There are five methods to comply with requirements for equipment that **emits smoke or grease.**
1. Unlisted Type I hoods built in accordance with CMC Section 508
  2. Listed Type I hoods (UL 710)
  3. Recirculating systems (UL 710B)
  4. Cooking appliances with reduced grease emissions (EPA 202 test)
  5. Downdraft appliances
- D. **Type II Hood Requirement:** There are three methods to comply with requirements for equipment that generate steam, heat, and products of combustion, **where grease or smoke is not present.**
1. Unlisted Type II hoods built in accordance with CMC Section 508
  2. Listed Type II hoods
  3. Dishwashing machines with a self-contained condensing system (UL 921)
- E. CMC Section 303.1 requires listed ventilation equipment to be installed and used in accordance with the manufacturer's installation and operating instructions. A copy of the instruction shall be readily available for review by the enforcement officer.
- F. **Special Cooking Equipment and Operations**
1. ***Table-top cooking operations:***  
Cooking equipment, which is located at customer dining tables, shall be provided with approved mechanical exhaust ventilation. Korean barbecues and Japanese Teppan-style cooking are examples of these table-top cooking operations.
  2. ***Table-side serving display operations:***  
Traditional serving display operations, such as flambéing, may not be required to provide mechanical exhaust ventilation, unless excessive amounts of smoke, grease, steam, vapors, and/or heat are emitted. These serving display operations are not intended to cook the food, but merely "finish off" the product prior to serving. Local building and fire officials should be contacted for their requirements.
- G. **Exemptions From Providing Mechanical Exhaust Ventilation**
1. Cal Code section 114149.1 (c) states: "This section shall not apply to cooking equipment when the equipment has been submitted to the local enforcement agency for evaluation, and the local enforcement agency has found that the equipment does not produce toxic gases, smoke, grease vapors, or heat when operated under conditions recommended by the manufacturer. The local enforcement agency may recognize a testing organization to perform any necessary evaluations."
  2. CMC Section 508.1 lists when hoods are required to be installed. Exceptions to this requirement are listed as follows:
    - a. Cooking appliance that is in accordance with UL 710 B for reduced emissions where the grease discharge does not exceed 2.9 E-09 ounces per cubic inch (oz/in<sup>3</sup>) where operated with a total airflow of 500 cubic feet per minute (cfm).

- b. Recirculating systems listed in accordance with UL 710B and installed in accordance with CMC Section 516.0.
- c. Dishwashing machines connected to a Type II duct system and exhausted directly to the outdoors.
- d. Dishwashing machines with a self-contained condensing system listed in accordance with UL 921 and installed in a space where the HVAC system has been engineered to accommodate the latent and sensible heat load emitted from such appliances.

## VI. Type I Hoods

### A. Unlisted Type I Hoods (Custom)

1. Type I hoods for use over charcoal and other solid-fuel charbroilers shall be provided with separate exhaust systems (e.g., separate exhaust duct and exhaust fan).
2. When different types of cooking equipment are installed under a common hood, the entire hood shall be designed using the formula that produces the highest flow rate. For example, a single hood installed over a gas charbroiler, fryer, and range, shall be designed using the formula for the charbroiler (Table 2).

The duty level for the hood shall be the duty level of the appliance that has the highest (heaviest) duty level of appliances installed underneath the hood. The tables below are used to calculate the minimum exhaust CFM for custom hoods only. CMC Section 508.10.1

$$\text{Exhaust CFM} = \text{AIRFLOW} \times \text{Length of hood}$$

#### a. Extra-Heavy-Duty-Cooking Appliances

*The minimum net airflow for hoods used for:*

- *solid fuel cooking appliances (charcoal, briquette, and mesquite)*

*shall be in accordance with Table 1.*

**Table 1**

TYPE OF HOOD	AIRFLOW (cubic foot per minute per linear foot of hood)
Backshelf/pass over	Not permitted
Double island canopy (per side)	550
Eyebrow	Not permitted
Single island canopy	700
Wall-mounted canopy	550

#### b. Heavy-Duty Cooking Appliances

*The minimum net airflow for hoods used for:*

- *gas under-fired **broilers***
- *gas chain (conveyor) **broilers***
- *electric and gas **wok ranges***
- *electric and gas over-fired (upright) **broilers***

*shall be in accordance with Table 2.*

**Table 2**

TYPE OF HOOD	AIRFLOW (cubic foot per minute per linear foot of hood)
Backshelf/pass over	400
Double island canopy (per side)	400
Eyebrow	Not permitted
Single island canopy	600
Wall-mounted canopy	400

### c. Medium-Duty Cooking Appliances

The minimum net airflow for hoods used for:

- electric and gas **hot-top ranges**
- gas open-burner **ranges** (with or without oven)
- electric and gas flat **griddles**
- electric and gas double sided **griddles**
- electric and gas **fryers** (including open deep fat fryers, donut fryers, kettle fryers and pressure fryers)
- electric and gas **conveyor pizza ovens**

shall be in accordance with Table 3.

**Table 3**

TYPE OF HOOD	AIRFLOW (cubic foot per minute per linear foot of hood)
Backshelf/pass over	300
Double island canopy (per side)	300
Eyebrow	250
Single island canopy	500
Wall-mounted canopy	300

### d. Light-Duty Cooking Appliances

The minimum net airflow for hoods used for:

- gas and electric **ovens** (including standard, bake, roasting, revolving, retherm, convection, combination convection/steamer, rotisserie, countertop conveyORIZED baking/finishing, deck, and pastry)
- **discrete element ranges** (with or without oven)
- electric and gas steam-jacketed **kettles** less than 20 gallons (76 L)
- electric and gas **pasta cookers**
- electric and gas compartment **steamers** (both pressure and atmospheric)
- electric and gas **cheesemelters**
- electric and gas **tilting skillets** (braising pans)
- electric and gas **rotisseries**
- electric and gas **salamanders**

shall be in accordance with Table 4.

**Table 4**

TYPE OF HOOD	AIRFLOW (cubic foot per minute per linear foot of hood)
Backshelf/pass over	250
Double island canopy (per side)	250
Eyebrow	250
Single island canopy	400
Wall-mounted canopy	200

## B. **Listed Type I Hoods (UL 710)**

1. Hoods that have been evaluated and listed shall be sized and installed in accordance with the terms of their listing and according to the manufacturer's instructions.
2. Refer to manufacturer specifications regarding maximum cooking temperature for specific equipment.

## C. **Recirculating Systems UL 710B – CMC Section 516**

1. Recirculating systems that have been evaluated and listed under UL 710B shall be sized and installed in accordance with the terms of their listing, according to the manufacturer's instructions, and CMC Section 516.
2. Since a nonducted exhaust system does not normally remove the heat from the exhausted air, additional air conditioning may be required.



#### D. Cooking appliances with reduced grease emissions (also known as EPA 202 test)

1. Cooking appliances that are in accordance with UL 710B for reduced emissions where the grease discharge does not exceed 2.9 E-09 ounces per cubic inch (oz/in<sup>3</sup>) (5.0 E-06 kg/m<sup>3</sup>) where operated with a total airflow of 500 cubic feet per minute (cfm) (0.236 m<sup>3</sup>/s) are not required to be under a hood (CMC Section 508.1).
2. These appliances shall be installed in accordance with the terms of their listing and according to the manufacturer's instructions.

#### E. Downdraft appliances – CMC Section 518

1. A downdraft appliance ventilation system has been listed as being capable of capturing and containing the effluent discharge from the appliance it is serving. These appliances shall be installed in accordance with the terms of their listing and according to the manufacturer's instructions.
2. Typical downdraft appliance ventilation systems includes both a cooking appliance and ventilation system, such as tables that have built-in downdraft exhaust systems with two fans. One fan pushes the smoke and the second fan draws air across the table. The cooking vapors are captured and carried to a grease duct that is attached to the bottom of the table and are exhausted outdoors.

### VII. Type II Hoods

#### A. Unlisted Type II Hoods (Custom)

1. Type II hoods shall be installed above equipment and dishwashers that only generate steam, heat, and products of combustion, **where grease or smoke is not present**.
2. The table below is used to calculate the minimum exhaust CFM for custom hoods only that are serving cooking appliances. CMC Section 508.10.1

$$\text{Exhaust CFM} = \text{AIRFLOW} \times \text{Length of hood}$$

#### Light-Duty Cooking Appliances

*The minimum net airflow for hoods used for:*

- *gas and electric **ovens** (including standard, bake, revolving, retherm, convection, combination convection/steamer, countertop conveyORIZED baking/finishing, deck, and pastry)*
- ***discrete element ranges** (with or without oven)*
- *electric and gas steam-jacketed **kettles** less than 20 gallons (76 L)*
- *electric and gas **pasta cookers***
- *electric and gas compartment **steamers** (both pressure and atmospheric)*
- *electric and gas **tilting skillets** (braising pans)*

*shall be in accordance with Table 4.*

**Table 4**

TYPE OF HOOD	AIRFLOW (cubic foot per minute per linear foot of hood)
Backshelf/pass over	250
Double island canopy (per side)	250
Eyebrow	250
Single island canopy	400
Wall-mounted canopy	200

3. "The net airflow for Type II hoods used for dishwashing equipment shall be not less than 200 cubic feet per minute (0.094 m<sup>3</sup>/s) per linear foot (m) of hood length." (CMC Section 508.10.1.6)

#### B. Listed Type II Hoods (UL 710)

1. Hoods that have been evaluated and listed shall be sized and installed in accordance with the terms of their listing and according to the manufacturer's instructions.

#### C. Dishwashing machines with a self-contained condensing system (UL 921)

1. "Dishwashing machines with a self-contained condensing system listed in accordance with UL 921 and installed in a space where the HVAC system has been engineered to accommodate the latent and sensible heat load emitted from such appliances as approved by the Authority Having Jurisdiction." This is an exception to the hood requirement in CMC Section 508.1.
2. Dishwashing machines under this standard shall be provided with an interlocking device to prevent opening of the appliance prior to completion of its cycle.

### VIII. Recommended Formulas for Specific Equipment

The following list is to be used as a guide to determine which hood type and table to use.

<u>Equipment</u>	<u>Hood Type</u>	<u>Table to Use</u>
Bain Marie (hot water bath)	*	—
Barbecue (solid fuel, e.g., wood or charcoal)	I+	1
Broiler (electric and gas over-fired, vertical/upright such as gyro or al pastor)	I	2
Charbroiler		
• Under-fired (solid fuel)	I+	1
• Under-fired (gas-fired, radiant and lava rock units)	I	2
• Salamander	I	4
• Under-fired (electric)	I	3
Cheesemelter (top browning and melting only)	I	4
Chinese Range (electric and gas wok)	I	2
Coffee Equipment		
• Urn or brewer	*	—
• Roaster (gas)	II	4
• Roaster (electric)	*	—
Corn on the Cob Warmer	*	—
Clam Shell Grill (small), for heating non-grease producing foods (tortillas, pastries, rolls, sandwiches from precooked meats and cheeses)	*#	—

Clam Shell Grill (large), for cooking grease producing foods (multiple hamburgers)	I	3
Crepe Maker (no meats)		
• Portable	*	—
• Nonportable	II	4
Deep Fat Fryer	I	3
Dishwashing Machine		
• High temperature	II	4
• Chemical sanitizing or any undercounter unit	*	—
Griddle, Grooved Griddle or Grill	I	3
Hot Dog Warmer	*	—
Hot Plate		
• Electric	*	—
• Gas (maximum of 5,000 BTUs)	*	—
• Induction cooktop	*	—
• Multiple units	*#	—
Kettle (electric and gas steam jacketed less than 20 gallons)	II	4
Kettle (candy)	II	4
Kettle Fryer (gas and electric)	I	3
Masa Cookers	II	4
Mongolian Barbeque	I	2
Ovens: <b>Without grease vapor generation</b>		
• Electric convection oven (max 250°F) ie. For baking bread products	*	—
• Gas or electric greater than 250°F ie. standard, bake, revolving, retherm, convection, combination convection/steamer, countertop conveyORIZED baking/finishing, deck, and pastry	II	4
Ovens: <b>With grease vapor generation</b>		
• Gas or electric (greater than 250°F) ie. standard, bake, roasting, revolving, retherm, convection, combination convection/steamer, rotisserie, countertop conveyORIZED baking/finishing, deck, and pastry	I	4
• Gas or electric conveyor pizza ovens	I	3
• Portable ovens (microwave, cook and hold)	*	—
• Solid fuel-fired (such as tandoori, pizza and baking)	I+	1

Panini Grill		
• For heating non-grease producing foods (tortillas, pastries, rolls, sandwiches from precooked meats and cheeses)	* #	—
• For heating grease producing foods	I	4
Pasta Cookers (gas and electric)	II	4
Popcorn popper		
• Without external grease vapor release	*	—
• With external grease vapor release	I	3
Pressure Fryer	I	3
Range		
• High temp, e.g., “hot tops”	I	3
• Stock pot range	I	3
• All others	I	3
Rethermalizer		
• Without external grease vapor release	II	4
Rice Cookers		
• Electric	*	—
• Gas	II	4
Rotisserie		
• Open or high temp	I	4
• Enclosed with max. ambient cavity temperature of 250°F	*	—
Skillet (electric and gas tilting or braising)	I	4
Smokers		
• Gas-operated utilizing solid fuel for flavoring	I	2
• Solid Fuel	I+	1
Steam Cooker	II	4
Steam Table (hot holding only)	*	—
Toaster (bread only)		
• Portable	*	—
• Nonportable	II	4
Waffle Cone Maker / Waffle Iron		
• Portable	*	—
• Nonportable	II	4

+Cooking equipment that uses solid fuel shall be provided with a separate exhaust system.

# Multiple units of the heating/cooking equipment proposed may be approved by the enforcement agency where it has been demonstrated that latent heat and excessive moisture has been sufficiently addressed.

\* Equipment marked with an asterisk typically does not need mechanical exhaust ventilation. However, the following criteria should be taken into consideration when determining the need for mechanical

exhaust ventilation:

- Installation of other unventilated heat generating equipment in the same area, e.g., refrigeration condensers, steam tables, or counter-top equipment;
- Presence of heating/cooling (HVAC) system;
- Size of the room or area where the proposed equipment will be installed, including ceiling height;
- How the proposed equipment will be operated, e.g., the types of food prepared, how often, etc.;
- Relative size of the proposed equipment, e.g., physical size and weight, BTU's/KW's;
- Nature of the emissions, e.g., grease, heat, steam, etc.;
- Temperature at which the proposed equipment operates. Cooking equipment that has a factory-set thermostat that cannot exceed 250°F normally does not need mechanical exhaust ventilation;
- Method of producing heat, e.g., gas, electricity, solid fuel, etc.
- Adequate amount of general ventilation: In poorly ventilated confined areas where the proposed equipment (like ovens and low-temp. dishwashers) is located, adequate general ventilation could be provided by a ceiling or wall exhaust fan that provides an air change rate of 3-5 minutes per change.

## **IX. Grease Filters**

- A. This section applies to grease filters installed in a listed or unlisted Type I hood. Refer to the listing and manufacturer's installation instructions for the grease filters within downdraft appliances and recirculating systems.
- B. Type I hoods shall be equipped with approved grease filters listed in accordance with UL 1046 to remove grease from the exhausted air.
- C. Grease filters are designed to remove grease particles from the exhaust air stream. Exhaust systems that have broken, missing, or undersized filters are prone to collect accumulations of highly combustible grease deposits throughout the entire duct system. Because of the chimney effect created in vertical ductwork, a very intense rapidly spreading flash fire can engulf the entire system.
- D. The most common grease filters currently in use are the baffle-type. Baffle-type filters simplify the cleaning process since most of the grease deposits run off the baffles to a collection device. The old style mesh-type filters are not acceptable in new installations. NFPA 96, ANSI NSF Standard 2, and UL 1046 no longer recognize the old style mesh type filters. They may present a fire hazard and decrease airflow as they become clogged with grease.
- E. Mesh filters shall not be used unless evaluated as an integral part of a listed exhaust hood or listed in conjunction with a primary filter in accordance with UL 1046.
- F. Grease filters and extractors shall be of such size, type, and arrangement as will permit the required quantity of air to pass through such units at rates not exceeding those for which the filter or extractor was designed and approved. The optimum operating velocities, measured in feet per minute (FPM), vary from filter to filter. Therefore, the manufacturer's specifications should be consulted to obtain the appropriate rates for each specific filter.
- G. *Number of Filters Required*
  1. It is important to select the proper number of grease filters for the hood. Too few filters increase the resistance to airflow and raise the filter cleaning frequency.

2. The minimum required number of filters for a particular hood can be calculated by dividing the total volume of air to be exhausted, in CFM, by the optimum operating velocity of the filter, in FPM. This number is then divided by the actual square footage of the filter (excluding the frame). The resulting figure represents the minimum number of filters required to efficiently remove the grease from the exhausted air.

Example:

Assume the following:

- An exhaust hood with a minimum required airflow of 3,250 CFM.
- Baffle type filters with a nominal size of 16" x 20", have an actual filtering surface of 14" x 18". (Nominal size minus the frame equals the actual filtering area.)
- An optimum operating velocity of 360 FPM for the filter.

$$\frac{\text{Volume of Air Exhausted}}{\text{Operating Velocity of Filter(FPM)}} = \text{Filter Area Needed (sq. ft.)}$$

$$\frac{3,250 \text{ CFM}}{360 \text{ FPM}} = 9 \text{ sq. ft.}$$

Next, convert the actual filter area to square feet:

$$14 \text{ in.} \times 18 \text{ in.} = 252 \text{ sq. in.}$$

$$\frac{252 \text{ sq. in.}}{144 \text{ sq. in./sq. ft.}} = 1.75 \text{ sq. ft.}$$

Then divide the 9-sq. ft. of needed filter area by sq. ft. per filter:

$$\frac{9 \text{ sq. ft.}}{1.75 \text{ sq. ft.}} = 5 \text{ filters}$$

Therefore, in this example, 5 filters would be required to provide adequate removal of the grease.

- H. Any space in the hood not occupied by a filter should be blanked off with sheet metal. Blanks may be placed above nongrease producing equipment such as a steam table, in order to achieve a better draw where it is needed the most. As much as possible, the blanks should be divided equally between the filters. This will ensure optimum performance and will equalize the air velocity over the entire length of the hood opening.
- I. It is important to install filters at the ends of the hood. However, grease filters should not be installed directly over a broiler flue, or any other flue from cooking equipment. Hot gases can make the filters very difficult to clean and may damage them.
- J. The distance between the grease filters and the cooking surface shall be a minimum

of 18 inches. Grease filters used with charcoal or charcoal-type broilers, including gas or electrically heated charbroilers, the distance shall be a minimum of 4 feet. Where grease filters are listed for separation distances less than the requirement, the listing requirements shall be permitted. Grease filters supplied as part of listed hood assemblies shall be installed in accordance with the terms of the listing and manufacturer's installation instructions.

- K. Filters shall be installed at an angle not less than 45 degrees from the horizontal and shall be equipped with a drip tray beneath the lower edge of the filter. This enables the grease to be collected in the drip tray and avoids grease dripping into food, or on food preparation surfaces.
- L. All grease collecting equipment shall be accessible for cleaning. Filter units shall be installed in frames or holders with handles so as to be readily removable without the use of tools, except where the system is designed for in-place cleaning.
- M. Proper hood design will keep the temperature at the filters less than 200° Fahrenheit. When the temperature at the filters is less than 200°F, the grease deposits will be brownish in color and can be easily removed. When the temperature exceeds 200°F, the grease deposits tend to bake on the filters. The color of the deposits will darken and become extremely difficult to remove.
- N. Filter equipped exhaust systems shall not be operated with damaged or missing filters.

## **X. Exhaust Hood Ducting**

- A. Ducting shall be installed in compliance with applicable sections of CMC, and local building and fire codes.
- B. This section applies to ducting serving a listed or unlisted Type I or Type II hood. Refer to the listing and manufacturer's installation instructions for the duct serving downdraft appliances.
- C. A separate duct system shall be provided for each Type I hood, except that a single duct system may serve more than one hood located in the same story of the building, provided that all hoods served by the system shall be located in the same room or adjoining rooms.
- D. Exhaust ducts from hoods shall be totally separated from all other ventilation systems.
- E. If the hood length exceeds 12 feet, it is necessary to provide two discharge ducts from the top of the hood to the main exhaust duct. For listed hoods, refer to the manufacturer's installation and operating conditions to determine if a distance of greater than 12 feet between ducts is permitted.
- F. Exhaust outlets for the exhaust hood ducting shall extend through the roof unless

otherwise approved by the local building official. Such extension shall be at least 24 inches above the roof surface; at least ten feet from an adjacent building, adjacent property line, or air intake into any building; and shall be located at least ten feet above the adjoining grade level. However, exhaust outlets for ducting may terminate at least five feet from an adjacent building, adjacent property line, or air intake into a building if the air from the exhaust outlet is discharged away from such locations.

- G. Exposed duct systems serving a Type I hood shall have a clearance of at least 18 inches from unprotected combustible construction. This clearance may be reduced to not less than three inches, provided the combustible construction is protected with material required for one-hour fire-resistive construction. Hoods less than 12 inches from the ceiling or wall, including the space between the duct and the duct shaft, shall be flashed solidly. Flashing shall be of either the same materials used in the construction of the hood, or of other materials conforming to one-hour fire-resistive construction. Check with your local building and fire authorities to determine other acceptable means of meeting this requirement.
- H. *Duct Sizing:* Duct systems serving a Type I hood shall be designed and installed in a manner to provide an air velocity within the duct system of not less than 500 FPM and not to exceed 2,500 FPM.
1. The duct leading from the exhaust hood to the exhaust outlet shall be sized correctly. The velocity of the exhaust air shall be high enough to minimize condensation on the various parts of the duct system.
  2. The following formula shall be used to determine the correct duct size:  
$$\frac{\text{Volume of air exhausted (CFM)}}{\text{Duct Velocity (FPM)}} = \text{Duct area needed (sq. ft.)}$$
- I. A circular duct requires a smaller space. If rectangular ducts are used, they should be as square as possible.
- J. The bends and elbows of the ductwork should be kept at a minimum. When elbows are used, a radius of 2 to 2 1/2 times the duct diameter is recommended. This will minimize the resistance against which the blower must move the air.
- K. Duct systems serving a Type I hood shall be constructed and installed so that grease will not collect in any portion of the ducting. The ducting shall slope not less than 1/4 inch per linear foot toward the hood or toward an approved grease reservoir. Where horizontal ducts exceed 75 feet in length, the slope shall be not less than one inch per linear foot.
- L. Any portion of the ducting that is inaccessible from the duct entry or discharge shall be provided with cleanout openings. Cleanout openings shall be equipped with tight fitting doors that are constructed of the same material and thickness as the ducting. The doors shall be equipped with latches that will hold the door tightly closed. Doors



shall be designed so that they can be opened without the use of tools.

- M. Ducts and plenums shall be constructed of carbon steel not less than .055 inch (No. 16 gage), or stainless steel not less than .044 inch (No. 18 gage) in thickness.
- N. All seams and joints shall have a liquid-tight, continuous external weld.
- O. All ducting that is exposed to the outside atmosphere and subject to corrosion shall be protected against such corrosion. Galvanization of metal parts, protection with noncorrosive paints, or installation of waterproof insulation are acceptable methods of protection.

## **XI. Exhaust Hood Installation Requirements**

- A. This section applies to ducting serving a listed or unlisted Type I or Type II hood. Refer to the listing and manufacturer's installation instructions for the installation requirements for listed hoods.
- B. Canopy hoods shall overhang, or extend a horizontal distance of at least 6 inches beyond the outer edge of the cooking surfaces on all open sides. This distance is to be measured from the inside lip of the hood.
- C. The vertical distance between the lower lip of the hood and the cooking surface shall not exceed 4 feet.
- D. Every portion of a Type I hood shall have a clearance from combustible construction of not less than 18 inches. This clearance may be reduced to not less than three inches provided the combustible material is protected with materials as specified for one-hour fire-resistive construction on the hood side.
- E. Canopy hoods shall be flashed to the ceiling and adjacent walls. The flashing shall be constructed of the same material and thickness as the hood. ***See Figures 4 and 5 for illustrations of the flashing methods.***
- F. Exhaust hoods shall be constructed of galvanized steel, stainless steel, or copper in compliance with the CMC.
- G. All joints and seams shall be liquid-tight and smooth for ease of cleaning. Approved construction methods and materials shall be used for sealing joints and seams.
- H. Pop rivets, metal screws, or other similar exposed fasteners shall not be used on the internal surfaces of a hood.
- I. Every hood shall be securely fastened in place by noncombustible supports. Exposed support hangers shall be of an easily cleanable design and construction. Threaded rods and chains are not acceptable.
- J. All conduit and fire protection piping shall be installed outside the hood, except for conduit or fire protection piping that leads from outside the hood directly to approved luminaires or fire protection nozzles located inside the hood. All conduit or piping installed inside the hood shall be installed at least 3/4 inch away from the hood

surface to facilitate cleaning.

## **XII. Eyeblink-Type Exhaust Hoods**

- A. Eyebrow hoods are acceptable for use with either Type I or Type II hoods, for medium or light duty cooking appliances only.
- B. Eyebrow hoods shall be installed in accordance with CMC Section 508.8.

## **XIII. Noncanopy-Type Exhaust Hoods**

- A. Noncanopy hoods shall be installed and sized in accordance with the manufacturer's installation instructions.
- B. Noncanopy hoods shall be installed with the edge of the hood set back not more than 1 foot from the edge of the cooking surface and the vertical distance between the lip of the hood and the cooking surface shall not exceed 3 feet.
- C. Noncanopy hoods are not permitted to be installed for "Extra Heavy Duty" cooking equipment. The volume of air exhausting through the noncanopy-type hood to the duct system shall be as follows:

<b>Duty level for cooking equipment</b>	<b>Minimum air flow exhausted per linear foot of cooking equipment</b>
Heavy Duty	400 CFM/Foot
Medium Duty	300 CFM/Foot
Light Duty	250 CFM/Foot

- D. Listed noncanopy exhaust hoods and filters shall be sized and installed in accordance with the terms of their listing and the manufacturer's installation instructions.

## **XIV. Water-Wash-Type Exhaust Hoods**

- A. This section applies to listed Type I hoods. Refer to the listing and manufacturer's installation instructions for the installation requirements.
- B. Water-wash-type hoods operate under the following principles: As the exhausted air moves at a high velocity past a baffle system, the heavier-than-air particles of grease are thrown out of the airstream by centrifugal force. The extracted grease is collected in grease gutters within the hood until removed by the daily cleaning cycle. The cleaning cycle is initiated when the exhaust hood is turned off. Hot detergent water is automatically sprayed onto the baffle system, thereby removing the grease deposits from the baffles. This wastewater is then drained off to the sewer or other approved waste removal system.
- C. In order to protect the potable water supply, an approved backflow prevention

device, such as a reduced pressure principle device (RP device), is required to be installed on the water inlet pipe, prior to the detergent pump solenoid.

- D. The wastewater from a water-wash-type hood shall be drained through an air gap separation into an approved receptacle, such as a floor sink.

## **XV. Make-up Air**

- A. Each room provided with an exhaust system shall have supplied to the room an amount of make-up air equal to the amount of air to be exhausted. If make-up air were not provided, the building would be under a negative pressure which could cause the following problems:
  - 1. The exhaust fan would not be capable of exhausting the design volume of air because the air would not be available.
  - 2. Negative pressure would cause improper venting of water heaters, space heaters, or other individually vented gas appliances in the building.
  - 3. A negative pressure will cause a surge of unconditioned outside air into the building whenever the doors are opened, which may also allow the entrance of flies into the facility.
- B. In order to provide an efficient air exchange system, the following factors should be taken into consideration when evaluating a make-up air system:
  - 1. The number and location of return air registers should be such as to provide uniform distribution of make-up air throughout the facility, taking into consideration cross drafts, room configurations, and required air flows.
  - 2. The use of properly designed registers and diffusers will help to slow down the air velocity and evenly distribute the make-up air.
  - 3. The make-up air registers should be located so as to prevent a short-circuiting of the air being supplied for the exhaust system.
- C. Windows and doors shall not be used for the purpose of providing make-up air.
- D. The exhaust and make-up air systems shall be connected by an electrical interlocking hardwired connector so that one system cannot be operated when the other system is off.
- E. Compensating hoods shall extract no more than 10% of their required exhaust airflow from the kitchen area around the hood. Compensating hoods, that have been evaluated and listed, shall be sized and installed in accordance with the terms of their listing, and according to the manufacturer's instructions.

## **XVI. Fire Extinguishing Systems**

- A. Approved automatic fire extinguishing systems shall be provided for the protection of commercial-type cooking equipment. The requirement for protection does not

include equipment that does not create or generate grease-laden vapors, such as steam kettles and steam tables.

- B. Deep fat fryers, ranges, griddles, broilers, and other cooking equipment which may act as a source of ignition for grease in the hood, grease removal device, or duct, shall be protected by approved fire extinguishing equipment installed in accordance with the fire code adopted by the jurisdiction. Necessary approvals shall be obtained from the local fire authorities prior to putting equipment into operation.

# **APPENDIX I**

## **Resources**

PG&E Food Service Technology Center [www.fishnick.com](http://www.fishnick.com)

UL Commercial Cooking Marking & Application Guide  
[https://www.ul.com/wp-content/uploads/2014/04/CommercialCooking\\_AG1.pdf](https://www.ul.com/wp-content/uploads/2014/04/CommercialCooking_AG1.pdf)

IAPMO Code Process <http://codes.iapmo.org/>

## **Installation Codes and Standards**

California Mechanical Code <http://epubs.iapmo.org/2016/CMC/#p=10>

Uniform Building Code

Uniform Fire Code

Uniform Plumbing Code

International Building Code

International Fire Code

International Mechanical Code

Uniform Plumbing Code

International Plumbing Code

International Fuel Gas Code

National Electrical Code (NFPA 70)

Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations (NFPA 96)  
[www.NFPA.org/96](http://www.NFPA.org/96)

## **Product Standards Used by Listing Agencies for Cooking System Components**

ANSI Z83.11, CGA 1.8 - Gas Food Service Equipment

ANSI/NSF 2 – Food Service Equipment

ANSI/NSF 4 – Commercial Cooking, Rethermalization and Hot Food Holding and Transport Equipment

ASTM E814 – Fire Tests of Through Penetration Fire Stops

ASHRAE 154- [www.ashrae.org](http://www.ashrae.org)

EPA Test Method 202

- UL Product Category Code KNLZ = Commercial Cooking Appliances with Integral Systems for Limiting Emission of Grease Laden Air

IAPMO PS 98 – Backflow Protection for Grease Fire Suppression Systems ICBO

AC101 – Grease Ducts, Flexible Enclosure Systems

ICBO AC105 – Recirculating Commercial Kitchen Hoods

ICBO AC121 – Grease Duct Systems, Self-Enclosed

UL 197 – Commercial Electric Cooking Appliances

UL 296 – Oil Burners

UL 300 – Fire Testing of Fire Extinguishing Systems for Protection of Restaurant Cooking Areas

UL 705 – Power Ventilators

UL 710 – Exhaust Hoods for Commercial Cooking Equipment

UL 710B – Recirculating Systems

- UL Product Category Codes:  
KNKG = Commercial Cooking Appliances with Integral Recirculating Ventilation Systems  
YZCT = Hoods/Recirculating Systems for Use with Specified Commercial Cooking Appliances

UL 762 – Power Ventilators for Restaurant Exhaust Appliances

UL 795 – Commercial-Industrial Gas Heating Equipment  
UL 921- Commercial Dishwashers  
UL 1046 – Grease Filters for Exhaust Ducts  
UL 1254 – Pre-Engineered Dry Chemical Extinguishing System Units  
UL 1479 – Fire Tests of Through Penetration Fire Stops  
UL 1570 – Fluorescent Light Fixtures  
UL 1571 – Incandescent Light Fixtures  
UL 1572 – High Intensity Discharge Fixtures  
UL 1978 – Grease Ducts  
UL 2162 – Wood-Fired Baking Ovens – Refractory Type  
UL 2221 – Fire Endurance Performance of Grease Duct Enclosure Assemblies Grease Ducts

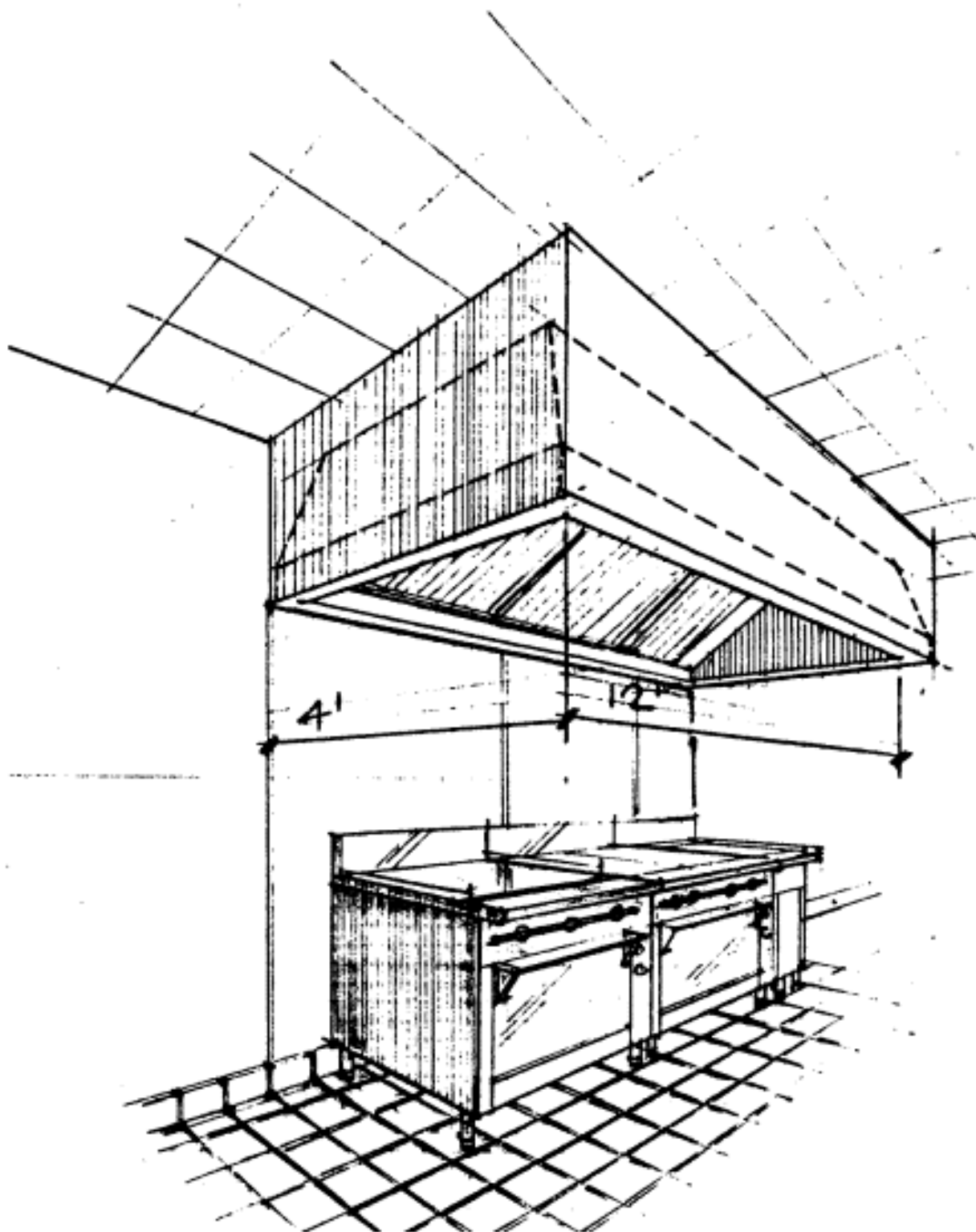
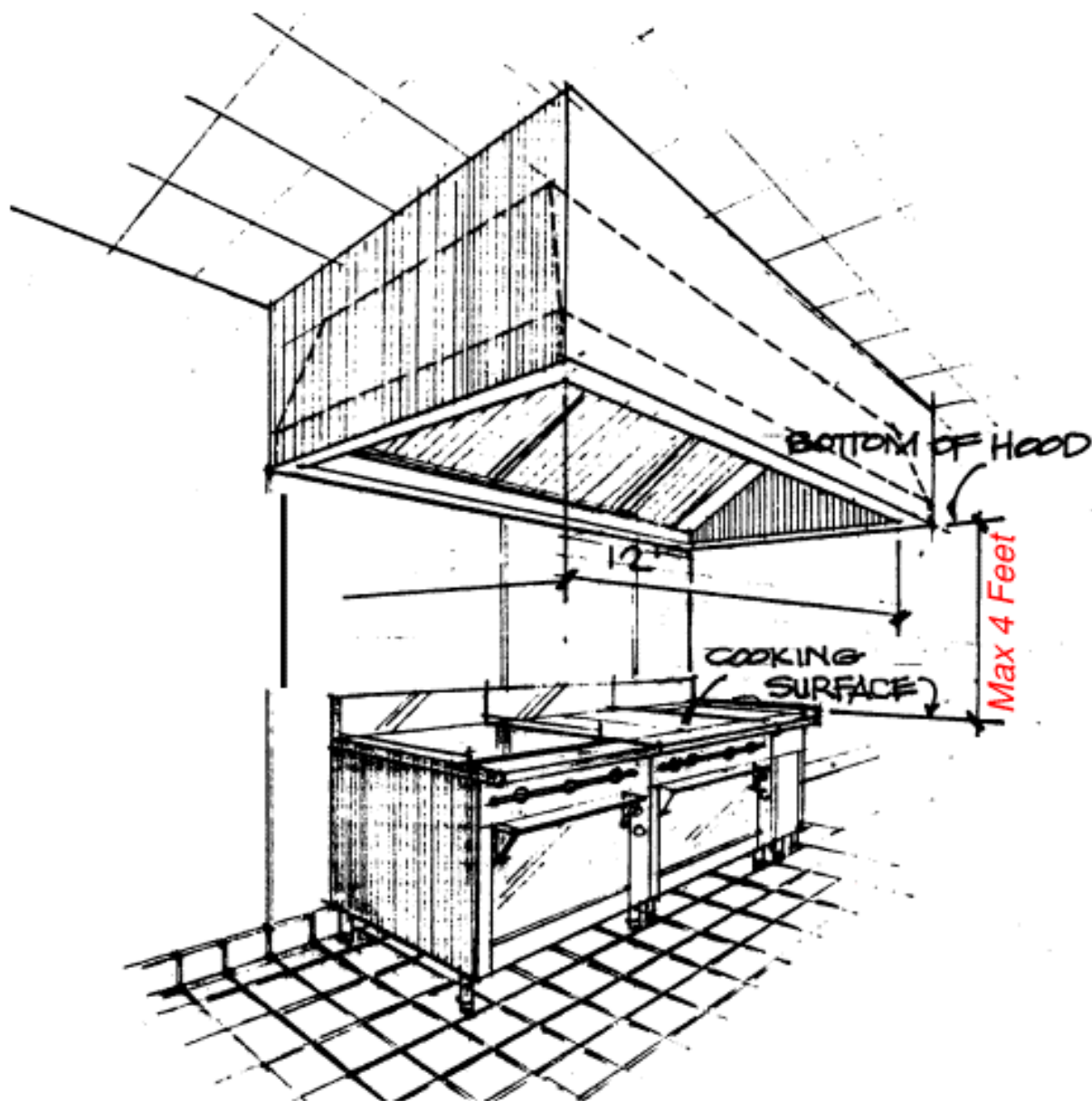


Figure 1  
*Canopy Hood*



**Figure 2.**  
***The distance between the lower lip of  
the hood and the cooking surface  
shall not exceed 4 feet.***



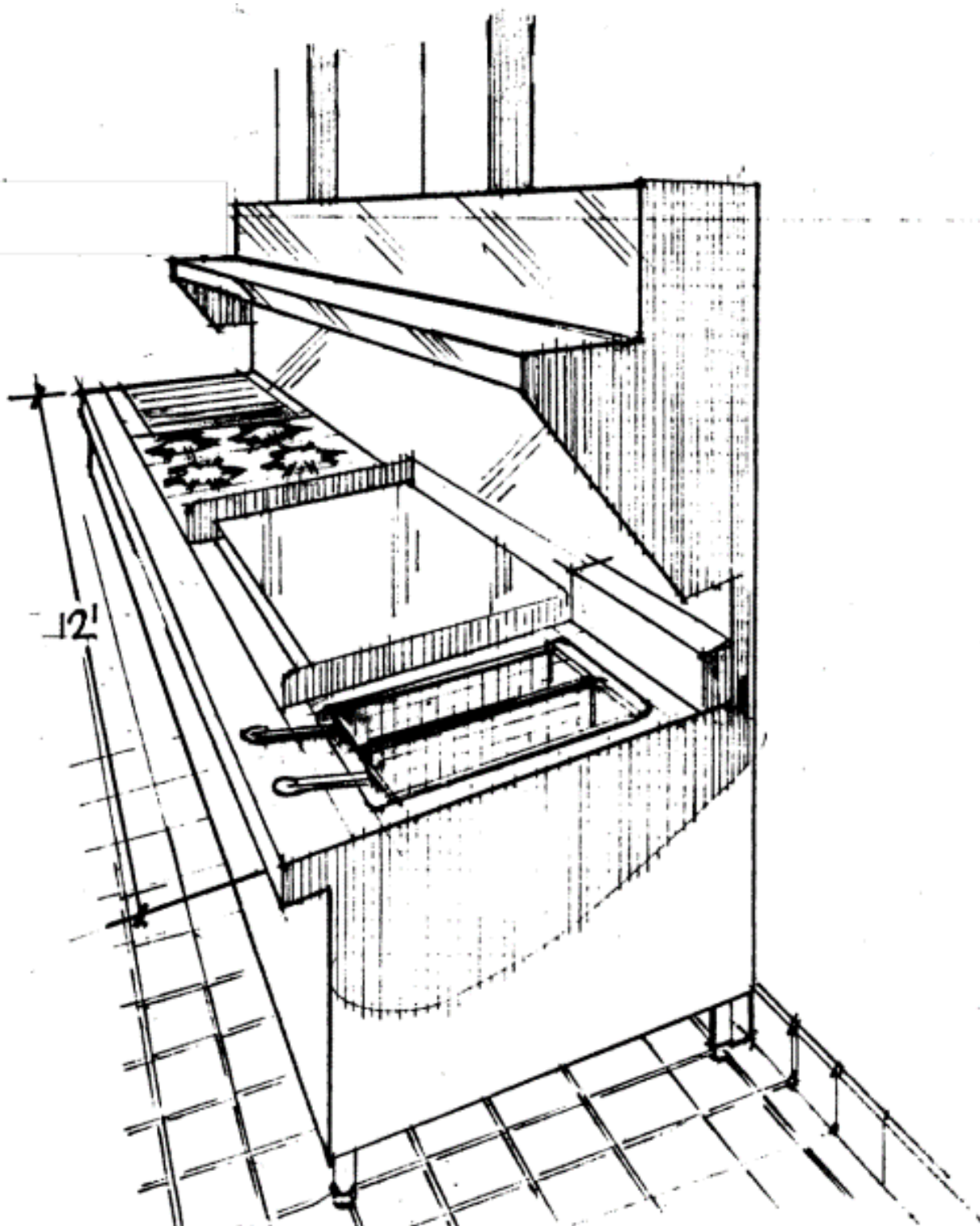
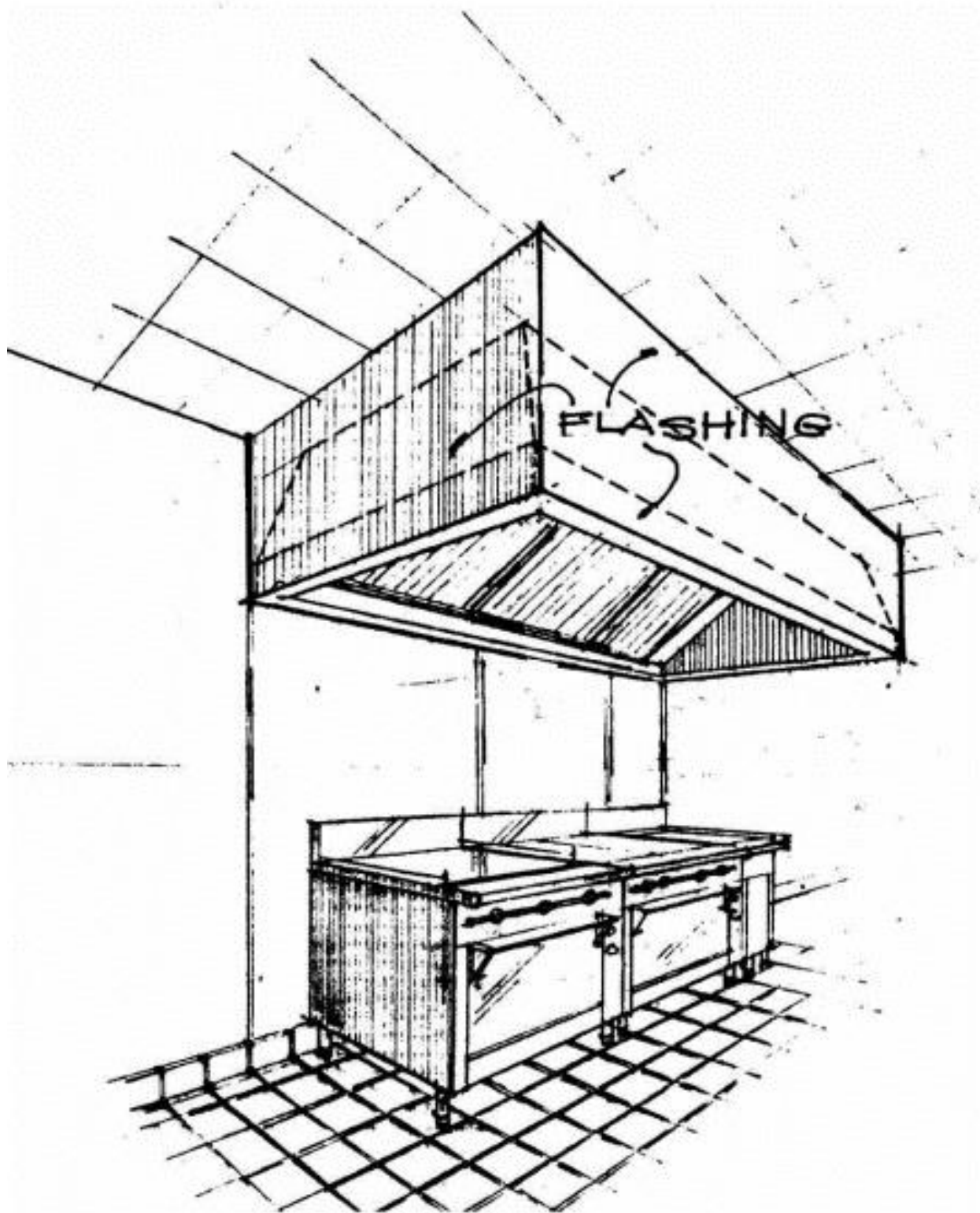
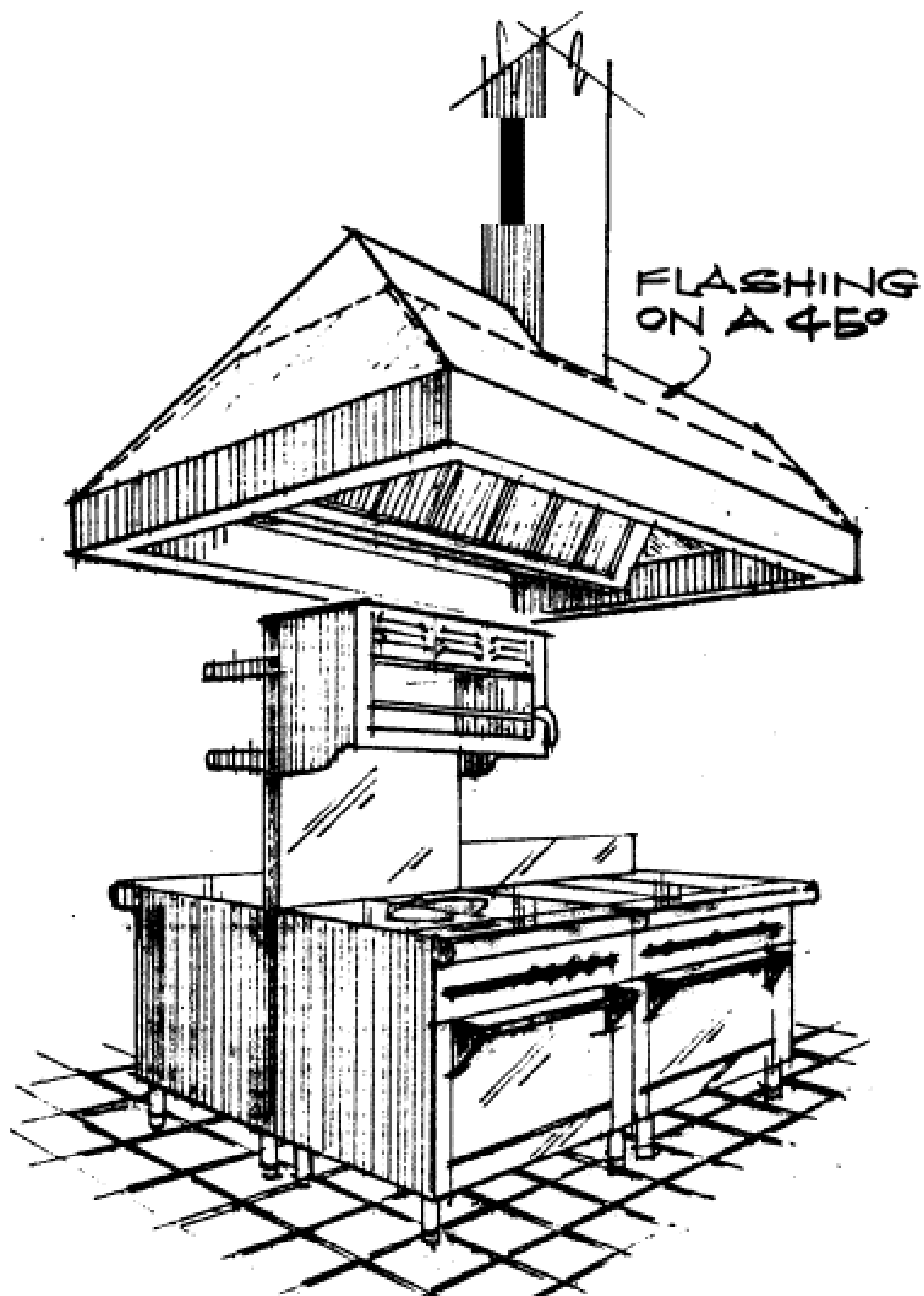


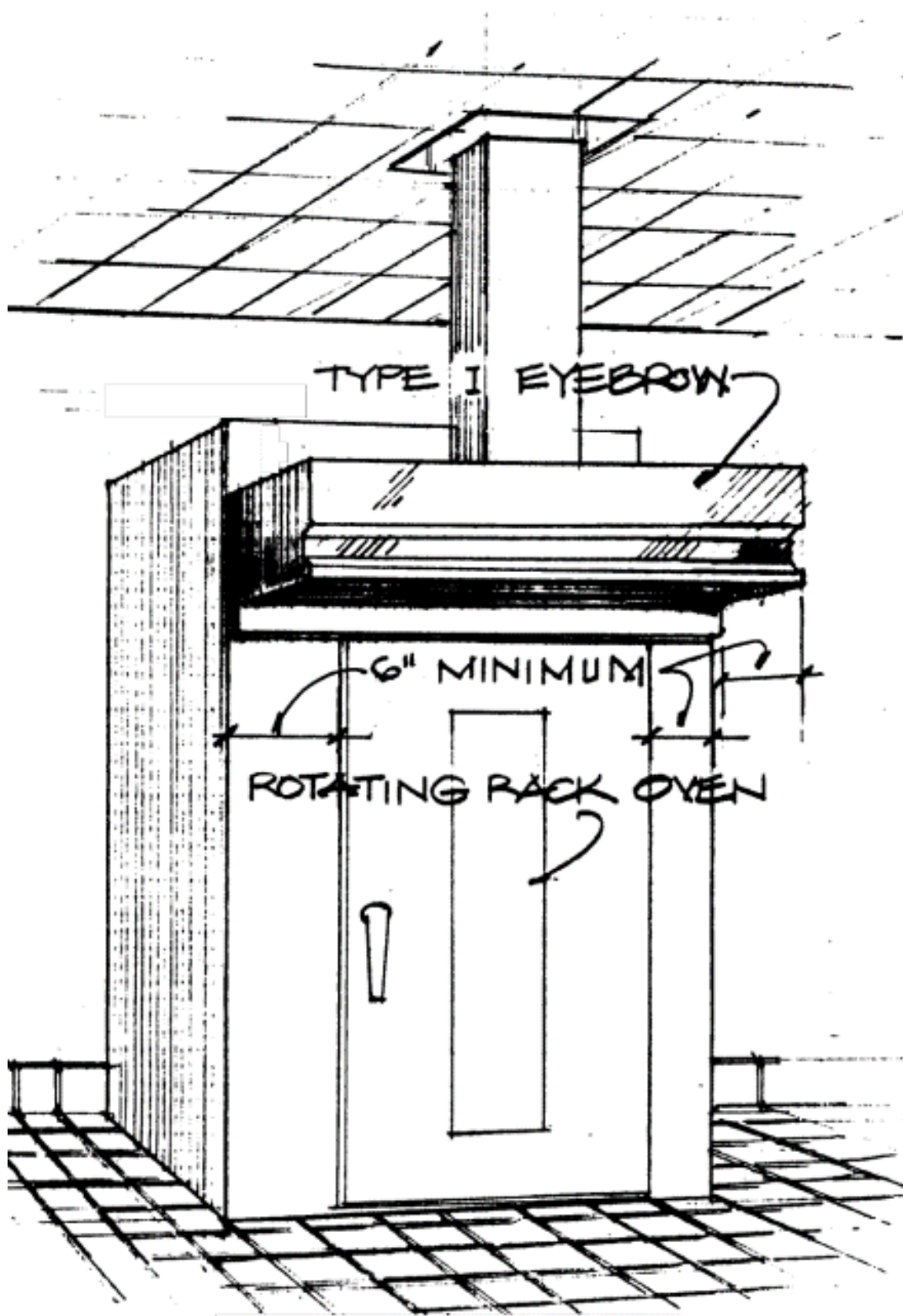
Figure 3.  
***Back shelf (Non Canopy) Hood***



**Figure 4.**  
***Canopy hoods shall be flashed to the  
walls and ceilings***



**Figure 5.**  
***Hood flashing***



**Figure 6.**  
***Eyebrow Hood***

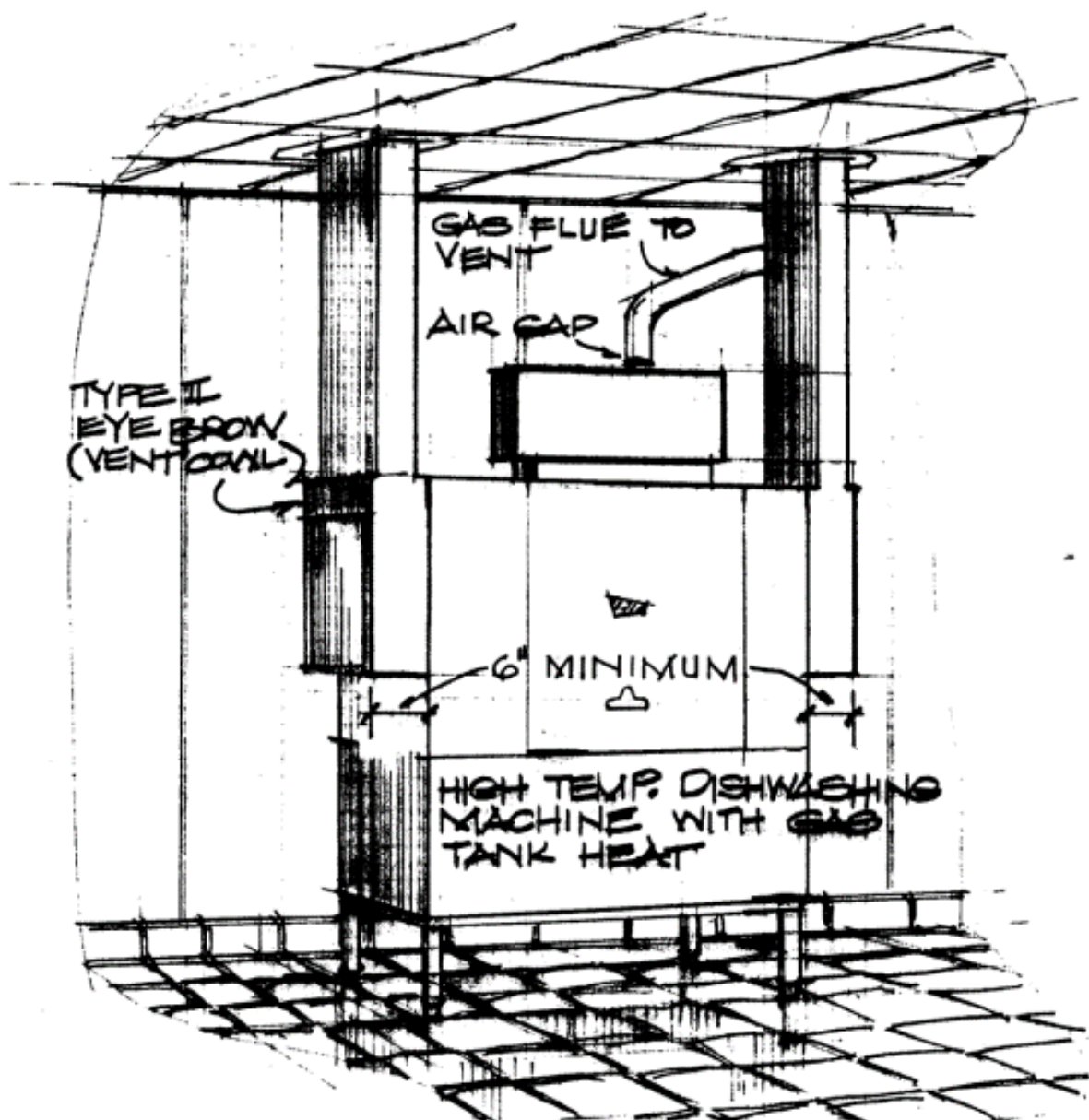


Figure 7.  
Type II Eyebrow at Dishwasher openings

