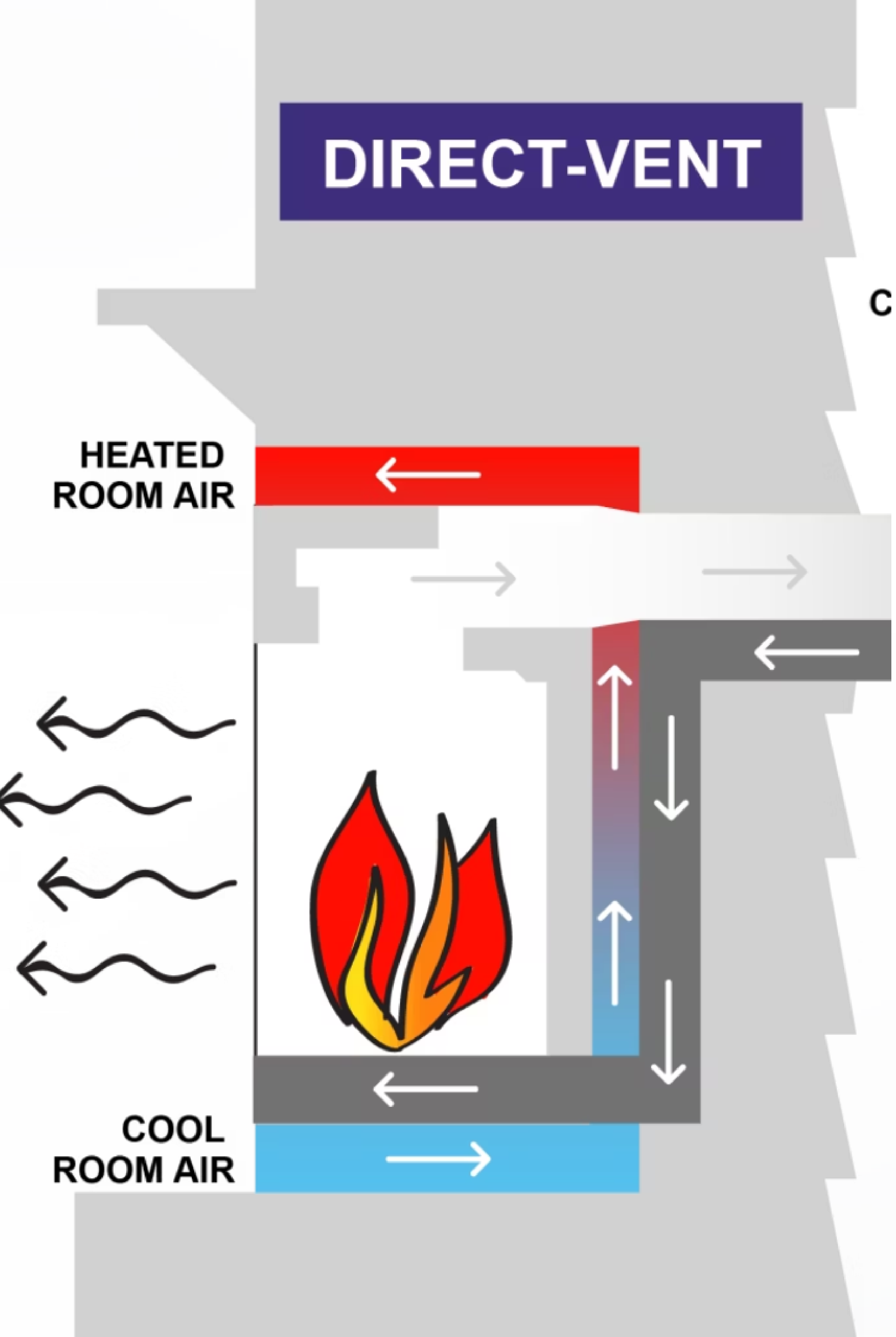

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CSA Unit 22 Venting Systems

Chapter 1

Gas technicians/fitters must be thoroughly familiar with the operating features of gas-fired appliances and how such appliances are categorized so that venting systems and system components match an appliance's particular requirements. Their relationship to the fundamental principles of draft is also discussed.

MK
Created
by Mike Kapin

Learning Objectives

Describe Vented Appliance Categories

Understand the four categories of gas appliances and their venting requirements

Review Draft Definitions and Effects

Learn about different types of draft and how they affect appliance operation

Describe Venting System Components

Identify and understand the various components that make up venting systems

Describe Vent Inspection

Learn proper techniques for inspecting venting systems

Locate and Size Air Supplies

For equipment with inputs of 400 MBtu/h or less and over 400 MBtu/h

Key Terminology

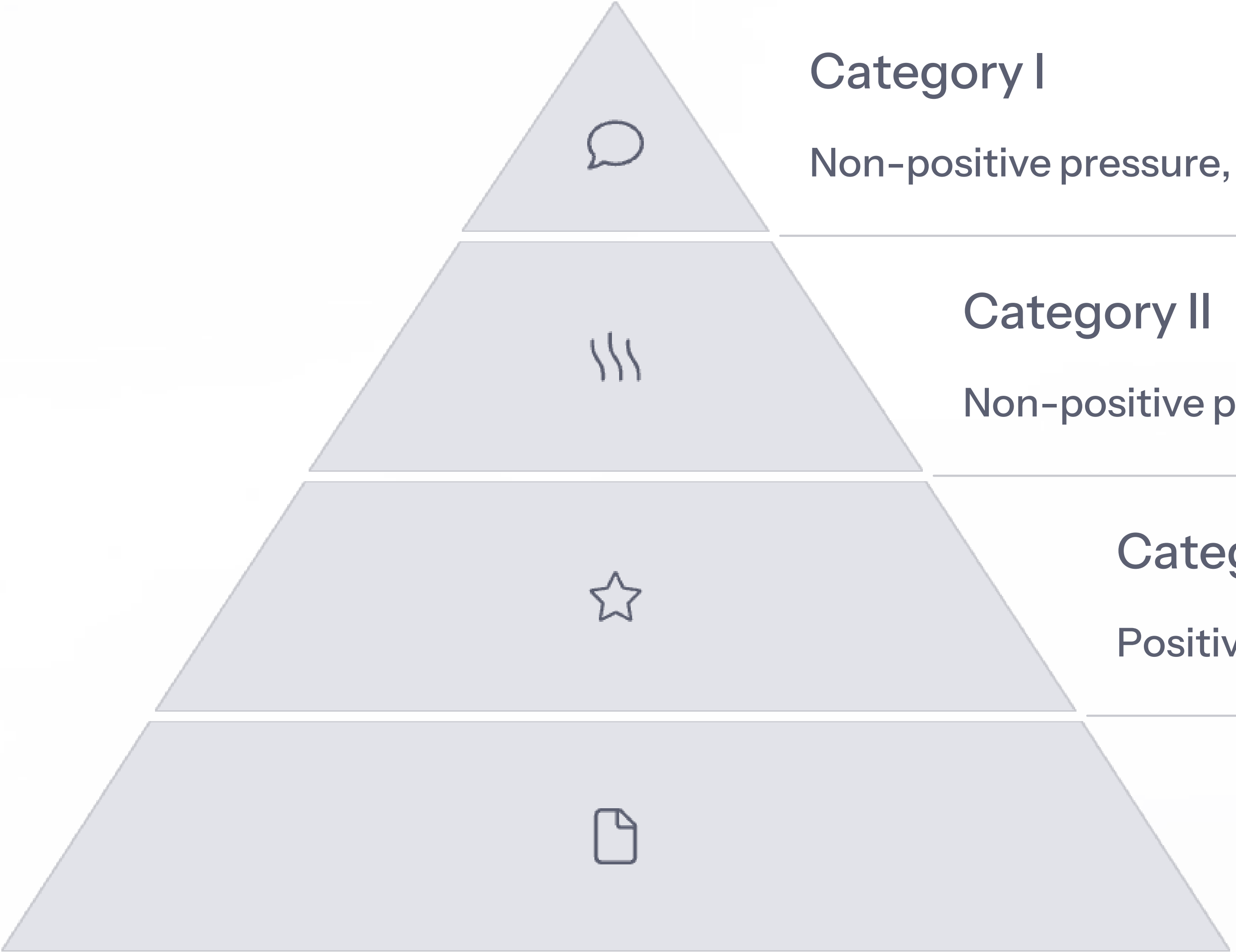
Term	Abbreviation (Symbol)	Definition
Backdraft		See Downdraft
Downdraft		Draft is reversed down and can cause products of combustion to spill
Draft		The flow of air or combustion gas products (or a combination of the two) through an appliance and its venting system
Heat reclaimer		A device that may be installed externally or internally to a venting system to extract heat from flue gases
Over-fire draft		The pressure measured over the flame in the combustion chamber compared to the pressure of the outside of the combustion chamber
Stack effect		Tendency of heated gas to rise in a vertical passage such as a chimney, a small enclosure or a stairwell

Red Seal Alignment

You can use the CSA Group Gas Trade Training materials as resources to help you prepare for the Red Seal Gasfitter – Class B exam. For more information on how these materials align with the 2014 national standard for the occupation of Gasfitter – Class B, please review an expanded reference matrix at https://store.csagroup.org/.

The CSA Group Gas Trade Training Materials align with various blocks and tasks in the 2014 Red Seal standard, particularly in areas like venting practices, safety-related functions, and installation of venting systems.

Vented Appliance Categories



Category I

Non-positive pressure, non-condensing

Category II

Non-positive pressure, condensing

Category III

Positive pressure, non-condensing

Category IV

Positive pressure, condensing

To ensure that venting provisions for gas-burning appliances match specific operating features, gas appliances are divided into four categories as defined by CSA B149.1. These categories are based on vent static pressure and flue loss characteristics.

Category I Appliances

Non-positive Pressure

Operates with non-positive (negative) pressure in the vent

Efficiency

Not less than 17% flue loss (maximum 83% efficient)

Non-condensing

Under continuous operation, no water will be collected internally or in the vent

Examples

Draft-hood-equipped appliances, fan-assisted appliances for venting into Type B vents and properly lined chimneys

Natural Draft (Negative Pressure)
Category I - Not airtight - Type B gas vent or listed Chimney Lined System, Type "L"*
Category II - Watertight & corrosion resistant - Vent system specified by manufacturer - UL 1738 Listed vent required.

Category II Appliances

Characteristics

- Non-positive pressure in the vent
- Less than 17% flue loss (greater than 83% efficient)
- Condensing operation

Category II gas-burning appliances are not commonly encountered in the field.

Examples

- Mid and high efficiency appliances designed for use with a power venter located at the outside wall termination
- Power venters maintain negative vent pressure
- Some direct vent, balanced flue appliances may fall into this category

Category III Appliances

Positive Pressure

Operates with positive pressure in the vent system

Efficiency Range

Not less than 17% flue loss (maximum 83% efficient)

Non-condensing

No water collection during continuous operation

Fan-assisted

Includes induced and forced-draft appliances

The fan or blower on this type of appliance produces sufficient draft to overcome the resistance of the burner and the vent system. Special sealed venting systems are required due to the positive pressure.

Category IV Appliances

High-Efficiency Design

Category IV includes high-efficiency, condensing-type appliances

Positive Pressure

Operates with positive pressure in the vent system

Condensing Operation

Less than 17% flue loss (greater than 83% efficient), water collects within the appliance or vent

Canadian Requirement

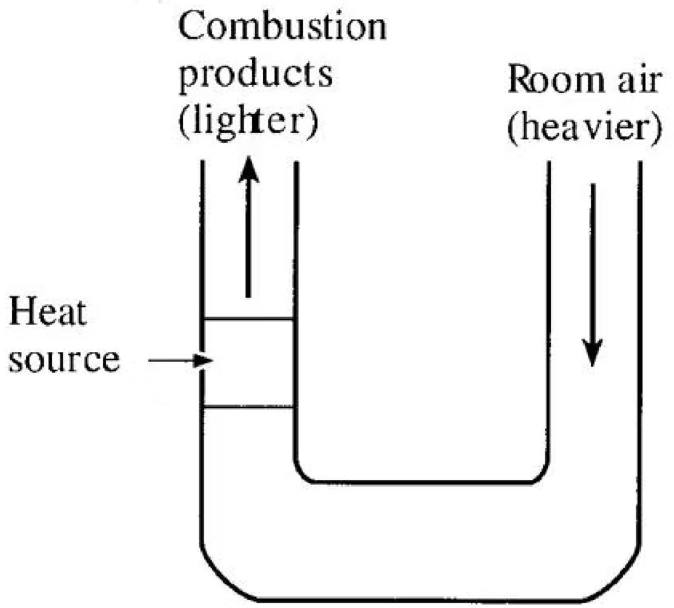
All forced air gas-fired furnaces manufactured or sold in Canada since January 1, 2010, are required to be high-efficiency, condensing-type appliances

Understanding Draft

Draft is the flow of air or combustion gas products (or a combination of the two) through an appliance and its venting system. It is indicated by the difference between the pressure at a specific point in the appliance or the venting system and the pressure of the air at the same elevation outside the appliance or the venting system.

The diagram above illustrates how draft works in a venting system, showing the pressure differences that create the flow of combustion gases.

Figure 1-1
Creating draft



Air/Gas Ratios

10 ft^3	30 ft^3	0.02 in
Combustion Air	**Total Air**	**Critical Pressure**
Required per 1000 Btu produced	May be required per 1000 Btu	Negative pressure limit for safe operation

Air is required for the combustion process to meet three requirements: air for combustion, dilution air for the draft diverter, and air for ventilation. To meet these requirements, for every 1000 Btu (0.293 kW) produced by burning natural gas or propane, up to 30 ft^3 (0.84 m^3) of air may be required. Additional air may be needed to compensate for the operation of range hoods, clothes dryers, and exhaust fans, which can cause a negative pressure condition in the building. A negative pressure of more than 0.02 inch w.c. (5 Pa) can cause natural draft appliances to spill the products of combustion into the building.

Types of Draft

Natural Draft

It is a draft other than mechanical draft. For example, a draft can be developed by the difference in temperature of hot gases in a vent or chimney and outdoor air temperature.

The natural-draft vent, or gravity vent, relies on the upward movement of hot gases creating a slight negative pressure in the vent or chimney. Blowers are not needed to assist draft with a gravity vent.

Mechanical Draft

It is the draft that a mechanical device (e.g., fan, blower, aspirator) produces and that may supplement natural draft.

Its two main types are:

- Forced draft - a product of a mechanical device upstream from the combustion zone of an appliance
- Induced draft - a product of a mechanical device downstream from the combustion zone of an appliance

Draft Effects: Downdraft

Downdraft (also called backdraft) is a condition of the venting system in which a draft is reversed down and can cause products of combustion to spill.

This diagram illustrates how downdraft can occur in a venting system, causing combustion products to spill into the living space instead of being safely vented outdoors. This is a dangerous condition that can lead to carbon monoxide exposure.

Figure 1-2
Downdraft

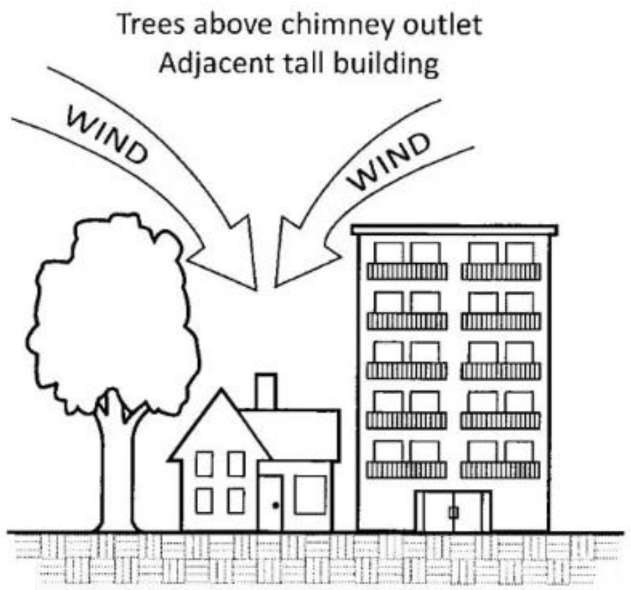
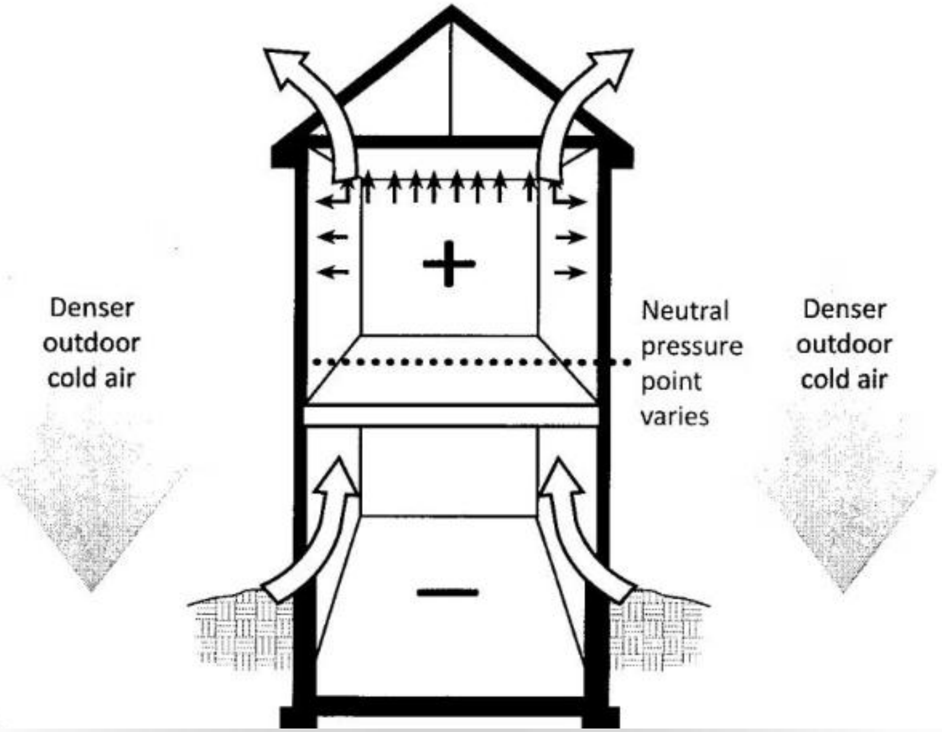


Figure 1-3
Stack effect



Draft Effects: Stack Effect

Heat Generation

Combustion creates hot gases

Temperature Difference

Hot gases are less dense than surrounding air

Upward Movement

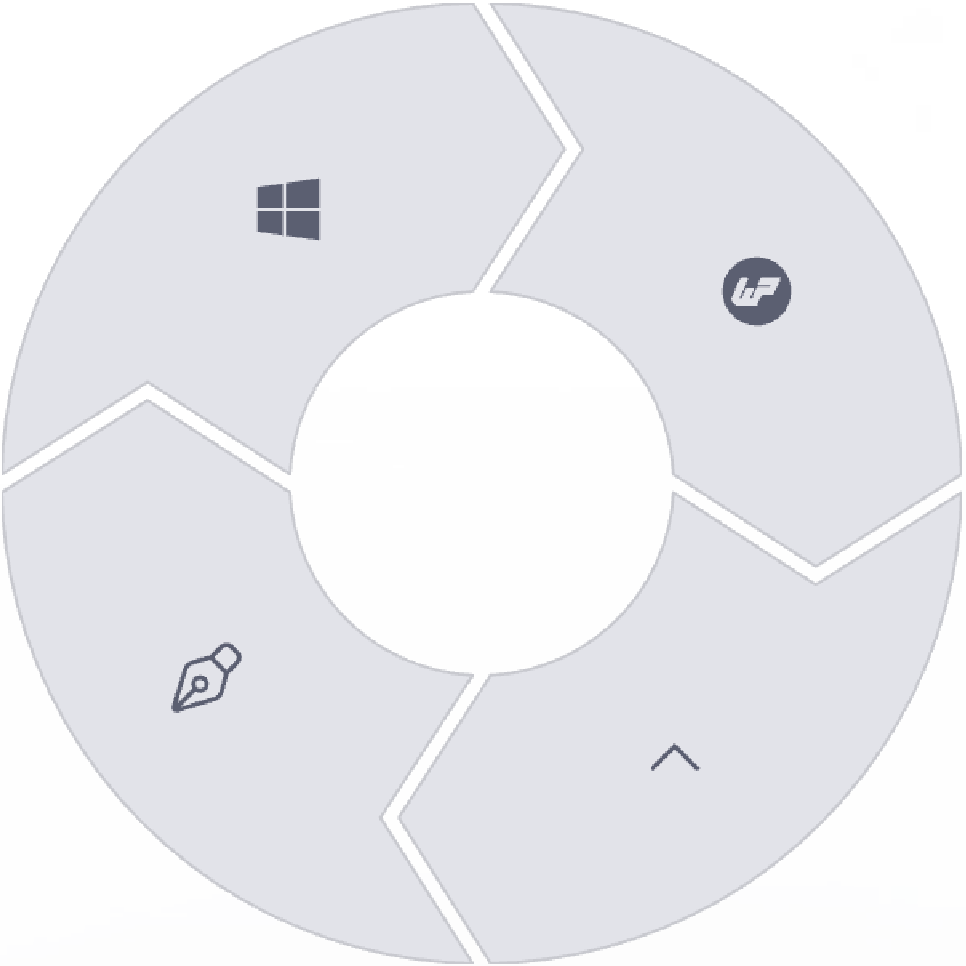
Less dense gases rise through the vertical passage

Continuous Flow

Creates ongoing draft as long as temperature difference exists

Stack effect is the tendency of heated gas to rise in a vertical passage such as a chimney, a small enclosure, or a stairwell. This natural phenomenon is the principle behind natural draft venting systems.

Draft Effects: Wind Effect



Wind Movement

Air flows across vent termination

Pressure Change

Creates negative (suction) pressure at termination

Eddy Currents

Can create variable pressure conditions

Increased Draft

Enhances upward flow of combustion gases

Wind effect is the likelihood of negative (suction) pressure at the vent termination that will increase draft to result from wind and eddy currents. This effect can enhance the performance of a venting system but can also cause issues if not properly accounted for in the system design.

Over-fire Pressure

Definition

Over-fire draft is the pressure measured over the flame in the combustion chamber compared to the pressure of the outside of the combustion chamber.

Positive Over-fire Draft

Has a positive pressure over the fire

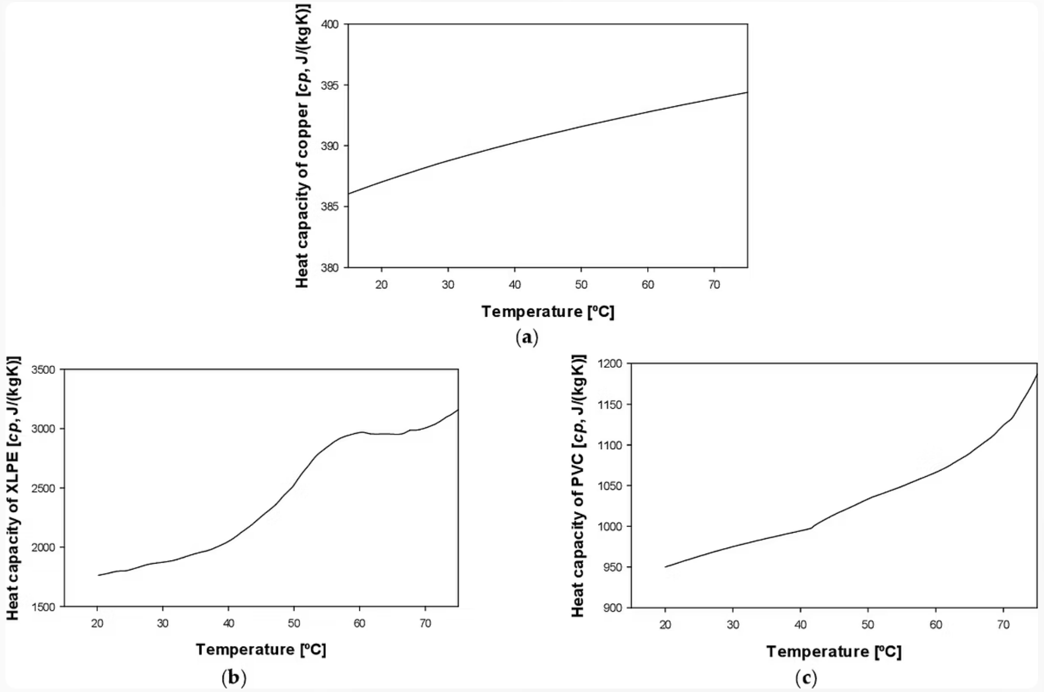
Negative Over-fire Draft

Has a negative pressure over the fire

Neutral Over-fire Draft

Has a neutral pressure over the fire

To prevent flue gas spillage, ensure that the heat exchanger and any portion of the venting system that is under positive pressure have sealing.



Theoretical Stack Draft

The quantity of theoretical draft in a stack, measured in inches of water column (or in Pascals), is directly proportional to the absolute temperature difference between the stack gas and its surroundings, and to the height of the stack. Draft does not depend on the diameter of the stack.

Stack Temperature

Draft will be greatest when average stack temperature is highest

Outdoor Temperature

Draft will be greatest when outdoor air temperature is lowest

Stack Height

Draft will be greatest when stack height is greatest

Theoretical Stack Draft Formula

Imperial Formula

$D = 7.6 \times H \times (1/T_a - 1/T_s)$

Where:

- D = theoretical draft (inches w.c.)
- Ts = average stack temperature (°R)
- Ta = outside temperature (°R)
- H = stack height (ft)
- 7.6 = constant

Metric Formula

$D = 3450 \times H \times (1/T_a - 1/T_s)$

Where:

- D = theoretical draft (Pa)
- Ts = average stack temperature (K)
- Ta = outside temperature (K)
- H = stack height (m)
- 3450 = constant

To take into account the heat lost through the stack walls as the hot gases pass through the stack, the average stack temperature (Ts) is the point halfway between the inlet temperature at the bottom and the outlet temperature at the top of the stack.

Vent Gas Temperature

1

Higher Temperature

Hotter vent gases are lighter

Greater Force

Creates stronger expulsion through vent

3

Better Performance

Results in more effective venting

Since the temperature inside a natural draft vent system represents the power available to operate the vent, the Btu/h (kW) capacity of the vent depends on the temperature. The hotter the vent gases, the lighter they are, and the greater the force that expels them through the vent. Average stack temperature is determined by taking an average of the temperature at the flue collar and the temperature at the vent termination.

Heat Loss in Venting Systems

Effects of Heat Loss

As hot flue gases travel through the vent system, they lose heat through the walls of the vent. As the gases cool, they become denser and the draft effect is lessened.

This heat loss can significantly impact the performance of natural draft venting systems, potentially leading to condensation and draft problems.

Vent Material Considerations

- Single-wall metal vents conduct heat readily to the surrounding air
- Some non-metallic materials used for vents may absorb large amounts of heat
- Double-wall, metal vents are often preferred because of the insulating quality of the air space between the walls
- The relatively small mass of metal in the inner wall of double-wall vents does not absorb much heat

Minimizing Heat Loss

Installation Requirements

CSA B149.1 and the vent manufacturer's instructions require the installation of the vent in an insulated space or its insulation

Exceptions

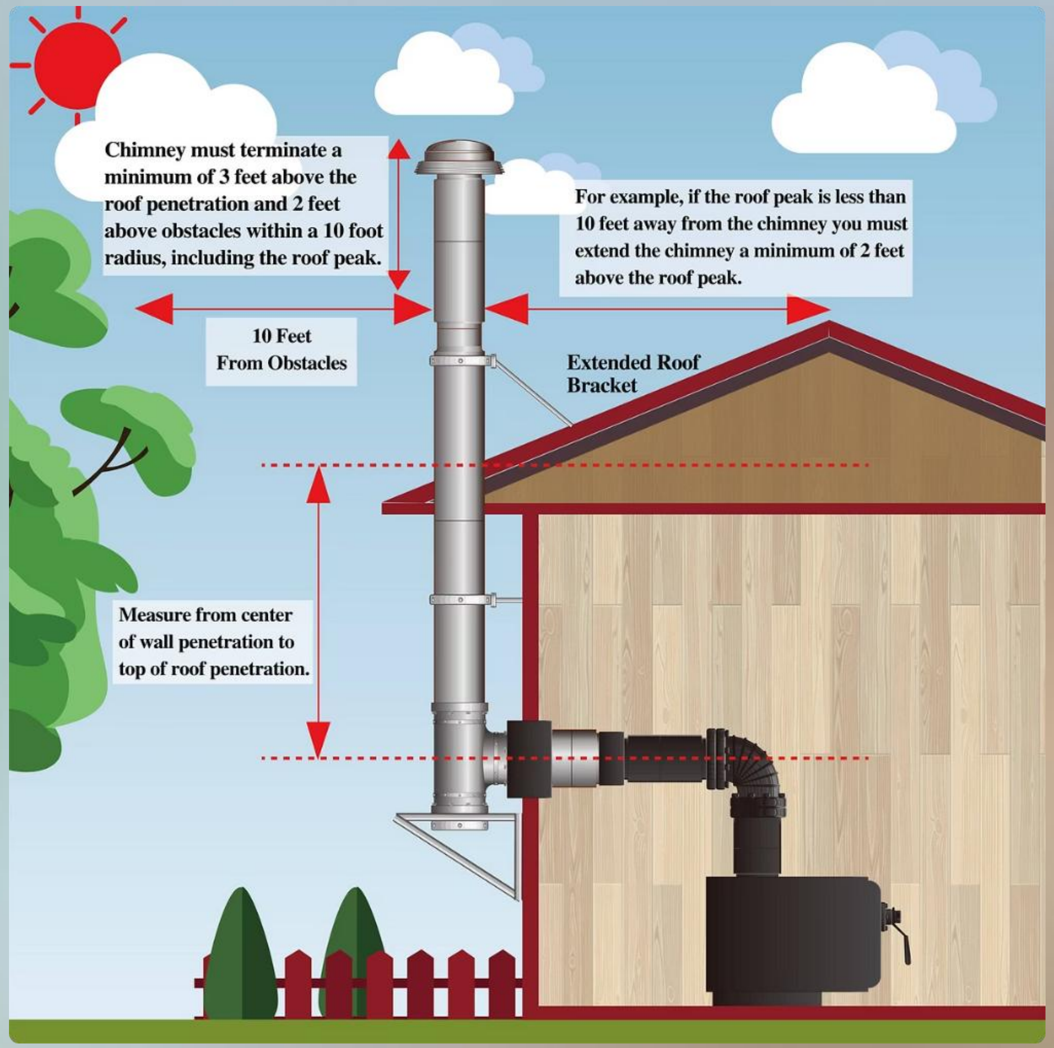
Insulation not required where the vent rises above the roof line or passes through an outside wall

Preferred Materials

Double-wall vents with air space insulation reduce heat loss

Temperature Maintenance

Proper insulation helps maintain flue gas temperature for better draft



Heat Reclaimers

Definition

A heat reclaimer is a device that you may install externally to a venting system to extract heat from flue gases.

Residential Applications

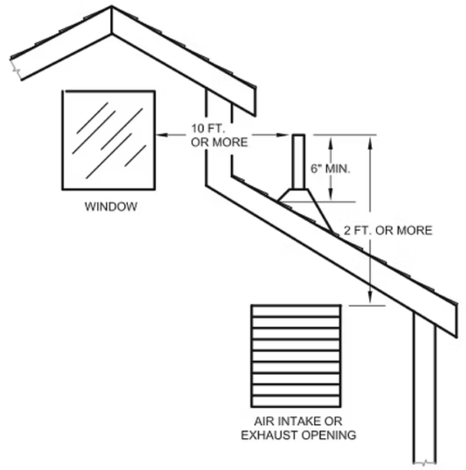
Never use a heat reclaimer with a gas-fired appliance that is installed in a dwelling unit, mobile home, or recreational vehicle unless it is approved for the application and installed in accordance with the manufacturer's certified installation instructions.

Commercial Applications

A heat reclaimer installed on a commercial or industrial gas-fired appliance must have approval for the application and be installed in accordance with the manufacturer's installation instructions.

Code Requirements

The Gas Codes have special requirements for heat reclaimers that must be followed for safe operation.



NOTES:

1. The separation of vent terminals from doors, windows, and air intake and exhaust openings keeps foul odors from entering the building.
2. The vent terminal is less than 2 feet above the window, but the window is 10 feet or more from the vent terminal horizontally.
3. The air intake or exhaust opening can be within 10 feet horizontally from the vent terminal if the vent terminal is 2 feet or more above the top of the opening.

Vent Height Considerations

1

Taller Columns

The taller the columns of hot gases, the greater the driving force

Increased Draft

In general, increasing the vent height increases the draft

Flow Resistance

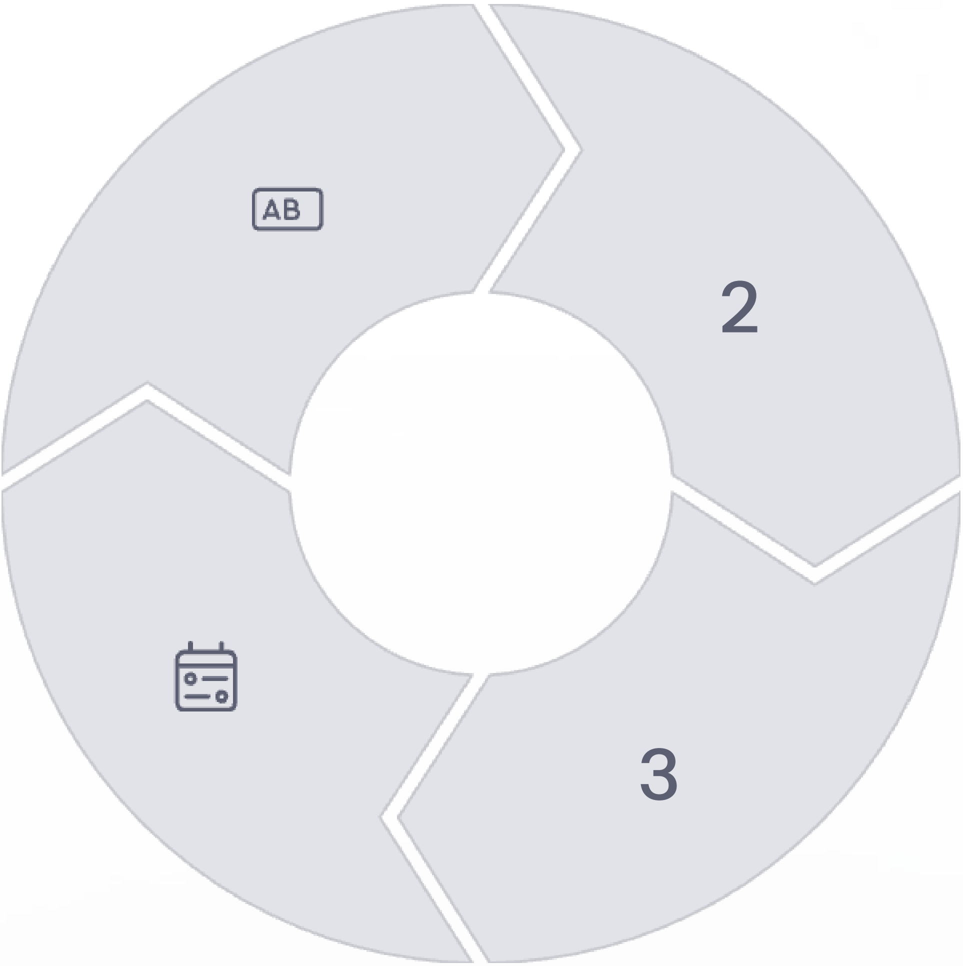
Increased total length also increases the resistance to flow

Practical Limit

There will be a limit at which no further benefit will be gained

You do not usually encounter this practical limit in actual practice, as most residential and commercial installations fall well within the effective range of vent heights.

Vent System Capacity



Input Relationship

Volume of flue gases is proportional to Btu/h input

Maximum Capacity

Every vent has a maximum input limit

Operating Range

Vent operates properly only between minimum and maximum inputs

Minimum Capacity

Each vent has a minimum input below which gases can condense

When the maximum limit is exceeded, a portion of the combustion products will not enter the vent, but will spill from the draft-hood into the surrounding space. The range between the maximum and minimum inputs is called vent capacity.

Venting System Components Overview

A venting system consists of everything involved in the venting of flue gases to the outdoors, including components that are integral to the appliance that affect venting.

Natural Draft Vent Systems

Include all components that form the vent itself, including:

- Vent connectors
- Type B vent
- Tile or other certified liner
- Inspection caps
- Cleanouts
- Firestops
- Supports
- Roof flashing
- Storm collar
- Rain cap

Also includes components integral to the appliance, such as combustion air inlets on the appliance cabinet and a manufacturer-supplied draft-hood.

Mechanical Draft Vent Systems

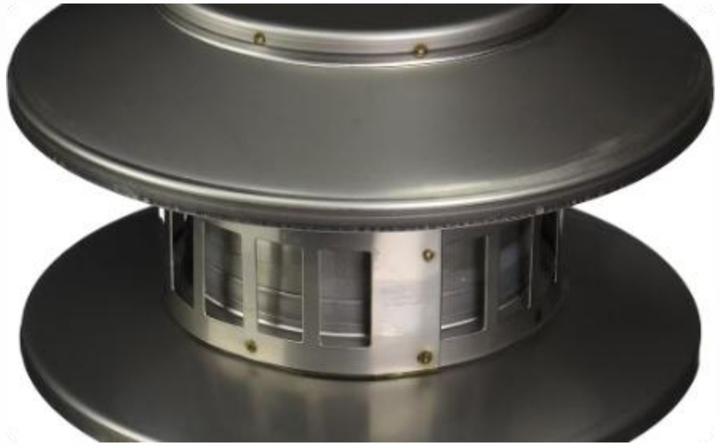
Components include:

- Blower
- Special vent material (BH vent)
- Termination kits
- Condensate traps
- Drainage equipment

Do not alter any of these components, as alteration can lead to failure of the system or improper venting that can result in the production of carbon monoxide (CO) into the building.

Figure 1-5
Components of a typical Category I natural draft venting system

Common Venting System Components



Rain Cap/Vent Top

Protects weather elements and foreign objects from entering the vent and reduces downdrafts caused by wind

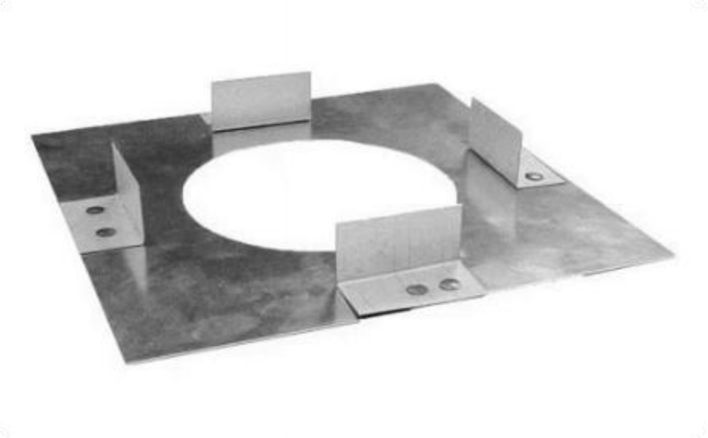
Storm Collar

Provides additional protection from water getting seeping between the vent and the roof flashing

Roof Flashing

Fitted around the vent to seal the roof penetration from rain and snow

More Venting System Components

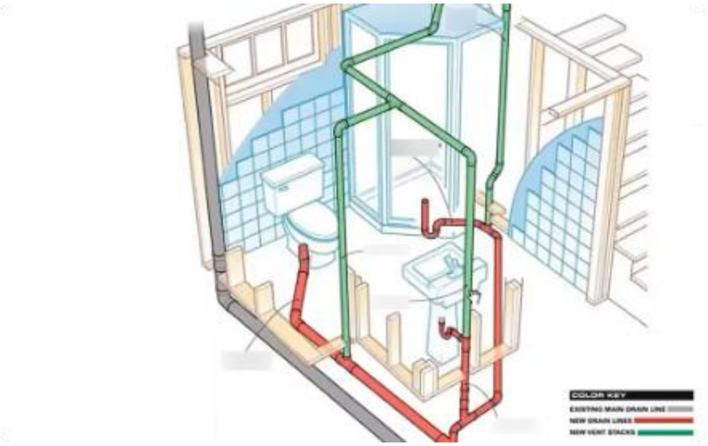


Fire Stop Spacers

Help contain the fire by restricting the stack effect during the fire. Firestops are required at each ceiling/floor penetration including an attic and are not required at the roof penetration.

Supports

Maintain clearances and carry the weight of the venting system to ensure proper installation and operation.



Complete Assembly

A venting system operates because a draft exists. Where required, the outdoor air supply is also considered part of the venting system.

Draft Control Devices

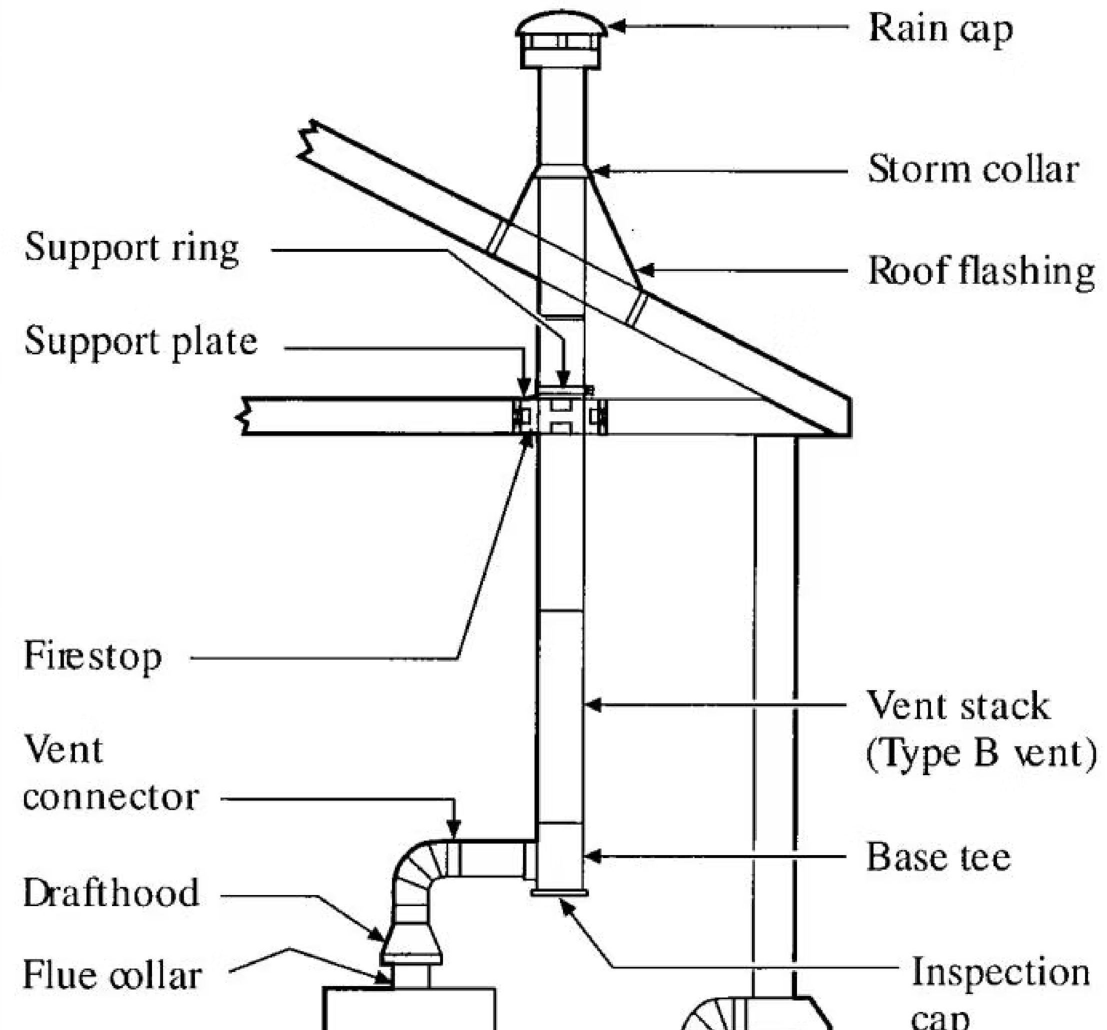
The majority of modern, highly efficient appliances a gasfitter will install have special venting systems that operate on mechanical draft. Lower efficient natural draft appliances rely on an external draft control device to maintain a neutral or slightly negative over-fire draft.

Types of Draft Control Devices

Two types of "draft control" devices used on natural draft appliances are:

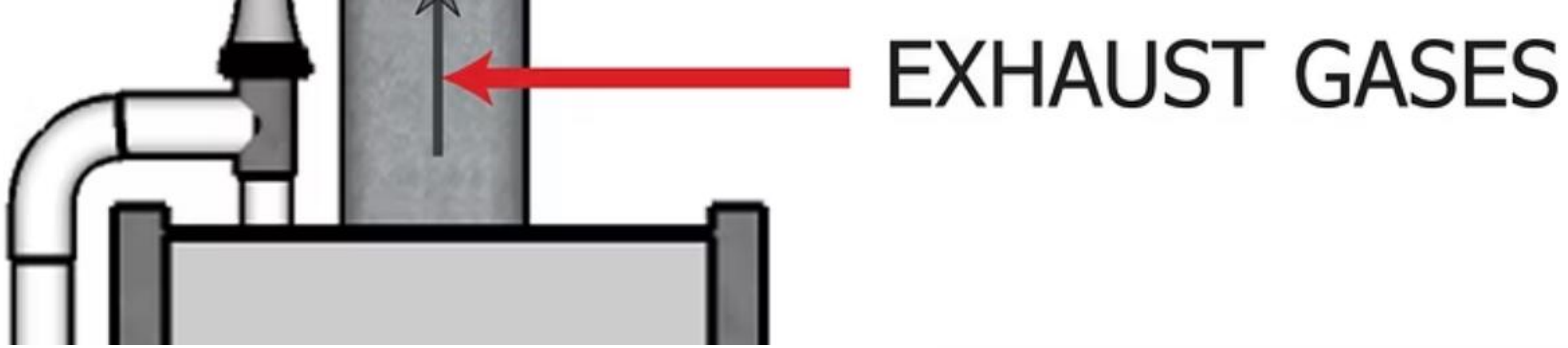
- Draft hood/diverter
- Barometric damper

These draft control devices control the over-fire draft by the introduction of dilution air, breaking the stack effect on the combustion chamber.



Purposes of Draft Control Devices

1. Control the over-fire draft by introducing dilution air
2. Relieve any downdrafts from entering the combustion chamber of the appliance
3. Allow the appliance to spill through the relief opening if the appliance vent is blocked or restricted



Draft Hood Operation

Combustion Process

Appliance burns fuel and produces hot flue gases

2

Dilution Air Introduction

Draft hood allows room air to mix with flue gases

Draft Stabilization

Maintains consistent draft conditions at the appliance

Downdraft Protection

Prevents downdrafts from affecting combustion process

A draft hood is a device built into an appliance or made a part of the vent connector that is designed to provide for the ready escape of the products of combustion in the event of no draft, backdraft, or stoppage beyond the draft hood. It also neutralizes the effect of stack action of the chimney or gas vent upon the operation of the appliance.

Barometric Damper Operation

Pressure Sensing

Damper responds to pressure changes in the vent

Automatic Adjustment

Door opens or closes based on draft conditions

Draft Regulation

Maintains consistent draft at the appliance

Dilution Air Control

Allows precise amount of room air to enter vent

A barometric damper is a mechanical device that automatically adjusts to maintain a constant draft in the vent system. It consists of a weighted door that opens or closes in response to changes in draft pressure, allowing more or less dilution air to enter the vent system as needed.

Venting System Types

Natural Draft Systems

Rely on the natural buoyancy of hot flue gases to create draft. Typically used with Category I appliances. Include draft hoods or barometric dampers to control draft.

Fan-Assisted Systems

Use a small fan at the appliance to help overcome flow resistance in the heat exchanger. Still rely on natural draft in the vent system itself. Common in mid-efficiency furnaces.

Power Vented Systems

Use a blower to force flue gases through the vent system. Can be side-wall vented. Used with Category III appliances and some Category I and IV appliances.

Direct Vent Systems

Draw combustion air directly from outdoors and vent flue gases directly outdoors through a sealed system. Common in high-efficiency appliances.

Type B Vent

Construction

Type B vent is a factory-made, double-wall vent pipe consisting of:

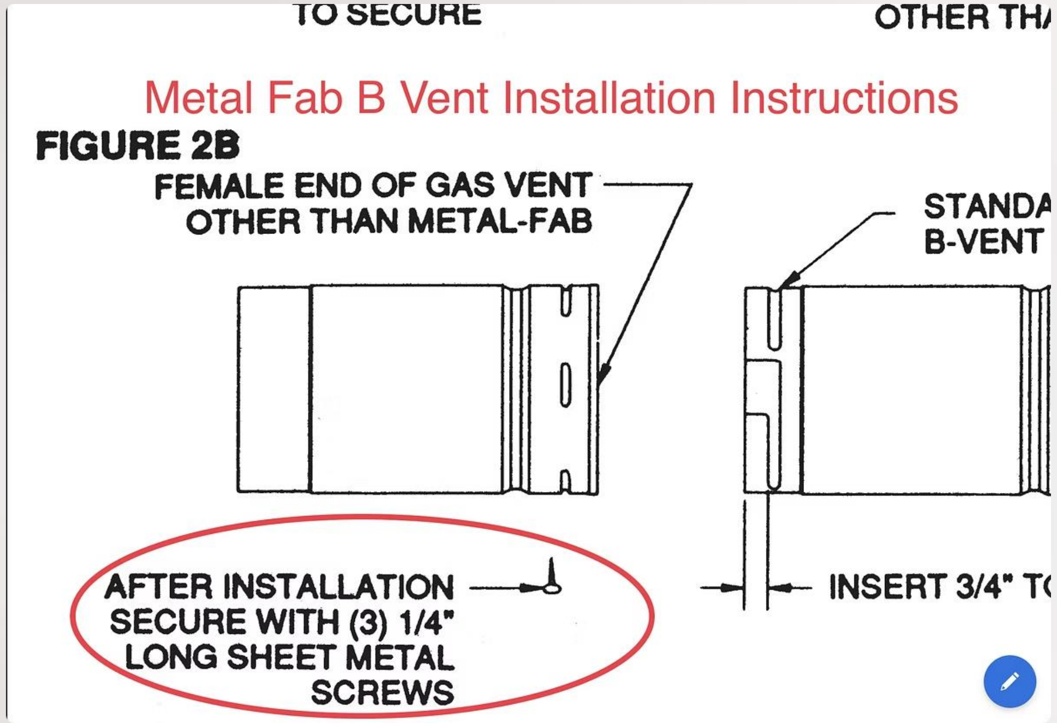
- An inner pipe of aluminum or stainless steel
- An outer wall of galvanized steel or aluminum
- An air space between the two walls that provides insulation

Applications

Type B vent is designed for:

- Venting Category I gas appliances
- Maintaining flue gas temperature to prevent condensation
- Reducing clearance to combustible materials
- Improving draft performance

Type B vent must be installed according to manufacturer's instructions and code requirements.



Type BH Vent

Special Vent Material

Designed for positive pressure and/or condensing applications

Sealed Joints

All joints must be sealed to prevent leakage of flue gases

Corrosion Resistant

Made from materials that can withstand acidic condensate

Applications

Used with Category III and IV appliances

Type BH vent is a special venting material designed for use with high-efficiency and positive pressure appliances. It is certified to ULC-S636 standard in Canada and must be installed according to manufacturer's instructions.

Masonry Chimneys

Traditional Venting

Masonry chimneys have been used for centuries to vent combustion appliances. They are constructed of brick, stone, or concrete blocks with a clay tile liner.

When used for venting gas appliances, masonry chimneys must:

- Be properly lined with a suitable material
- Be sized correctly for the appliance(s) being vented
- Be in good condition with no cracks or deterioration
- Have proper clearance to combustible materials

Common Issues

Masonry chimneys can present several challenges when used for venting gas appliances:

- Large thermal mass can cause condensation with modern appliances
- Often oversized for replacement appliances
- May have deteriorated liners or mortar joints
- Can be affected by wind and pressure conditions

Relining with appropriate materials is often required when connecting gas appliances to existing masonry chimneys.

Chimney Liners

Clay Tile Liners

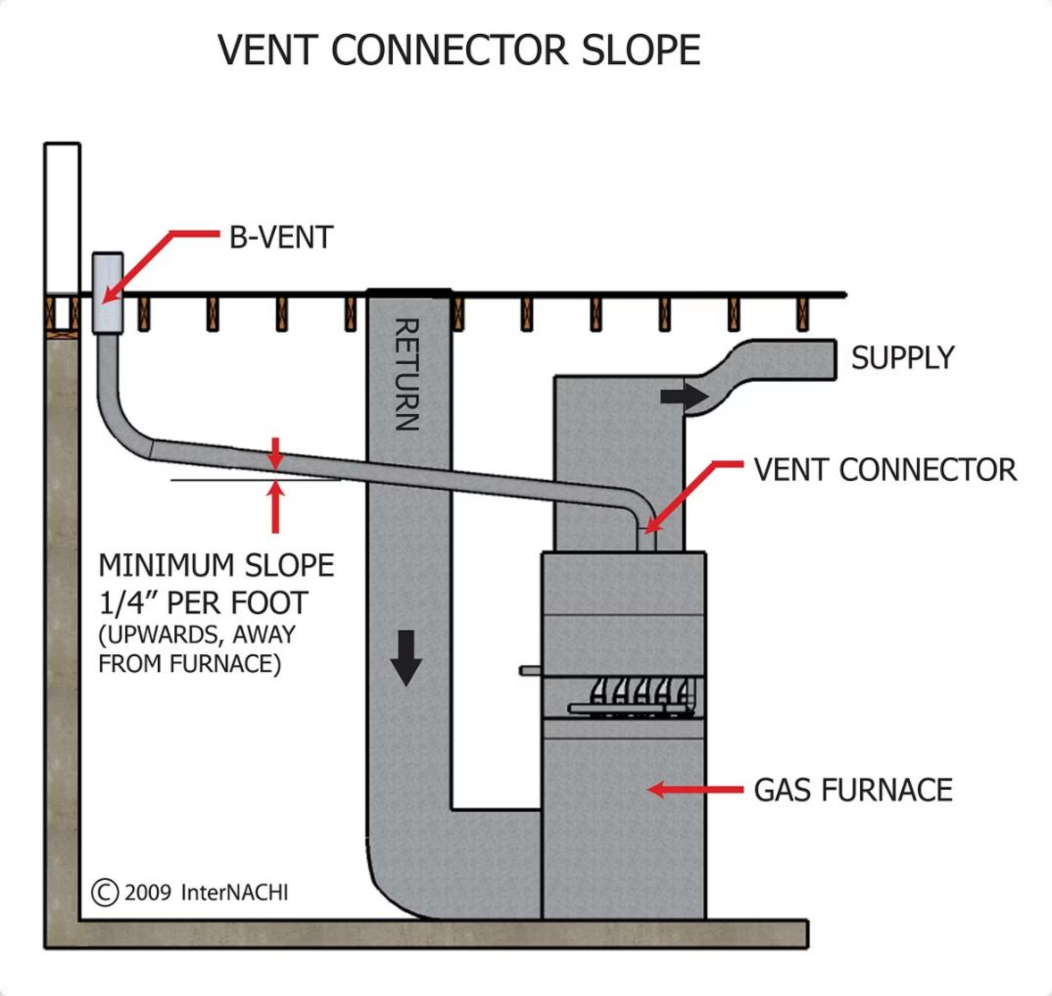
Traditional material for lining masonry chimneys. Must be in good condition with no cracks or missing pieces. May not be suitable for condensing appliances due to potential for deterioration from acidic condensate.

Metal Liners

Stainless steel or aluminum liners can be installed inside existing chimneys. Provide better performance with modern appliances. Available in flexible or rigid forms to accommodate different chimney configurations.

Cast-in-Place Liners

Lightweight, cement-based product that is poured or pumped into the chimney to create a seamless liner. Good for irregular or damaged chimneys. Provides excellent insulation and sealing properties.



Vent Connectors

Purpose

Vent connectors join the appliance flue collar to the vertical portion of the venting system

Materials

May be single-wall or double-wall metal depending on the application and clearance requirements

Installation Requirements

Must be installed with proper slope, support, and clearances according to code requirements

Sizing Considerations

Must be properly sized based on appliance input and connector length

Vent connectors are an important part of the venting system and must be installed correctly to ensure proper draft and safe operation of the appliance. They should be as short and straight as possible, with minimal bends to reduce resistance to flow.

Vent Terminations

Vertical Terminations

Traditional method of terminating vents through the roof. Requires proper clearance above the roof line and appropriate rain cap to prevent water entry while allowing flue gases to exit.

Horizontal Terminations

Common with power-vented and direct-vent appliances. Must be located away from building openings, corners, and other areas where flue gases could re-enter the building or affect adjacent properties.

Concentric Terminations

Used with direct-vent systems to provide both combustion air intake and flue gas exhaust through a single wall or roof penetration. Reduces the number of building penetrations required.

Condensate Management

Condensate Formation

High-efficiency appliances produce acidic condensate

Collection System

Condensate traps and drains collect the liquid

3

Neutralization

May require treatment before disposal

4

Proper Disposal

Connected to appropriate drain system

Category II and IV appliances produce condensate that must be properly managed. The condensate is acidic (typically pH 3-5) and can damage materials it contacts. Proper condensate management includes collection, possible neutralization, and disposal according to local codes.

Vent Clearances

Vent Type	Clearance to Combustibles	Notes
Single-wall metal	6 inches (15 cm)	Higher temperature, greater clearance required
Type B double-wall	1 inch (2.5 cm)	Air space between walls provides insulation
Type BH (Class I)	As specified by manufacturer	Varies by temperature rating
Type BH (Class II & III)	As specified by manufacturer	For higher temperature applications

Proper clearances to combustible materials must be maintained for all venting components. These clearances are established by testing and certification of the venting materials and are critical for fire safety.

Common Venting

Definition

Common venting refers to the practice of connecting two or more appliances to a single vertical vent or chimney. This approach is often used in residential and light commercial applications to simplify venting and reduce the number of roof or wall penetrations.

Common venting is only permitted for certain types of appliances and must be carefully designed to ensure proper operation of all connected appliances.

Requirements

- Only Category I appliances may be common vented
- Appliances must be located on the same floor
- Proper sizing using approved methods is critical
- Each appliance must have its own draft hood or barometric damper
- Connectors must enter the common vent at different levels if entering from opposite sides
- Larger appliance connector should be connected to the common vent first

Vent Sizing Principles

Appliance Input

Based on the Btu/h rating of the appliance(s)

Vent Height

Measured from draft hood to termination

Connector Length and Rise

Affects overall system performance

Sizing Tables

Use approved tables from codes or standards

Proper vent sizing is critical for safe and efficient operation of gas appliances. Undersized vents can cause spillage of combustion products, while oversized vents can lead to condensation and deterioration of the venting system.

Vent Sizing Methods

Sizing Tables

The most common method uses tables in codes and standards such as the National Fuel Gas Code (NFPA 54/ANSI Z223.1) in the US or CSA B149.1 in Canada. Tables account for appliance input, vent height, and connector configuration.

Manufacturer's Instructions

Always follow the appliance manufacturer's specific venting instructions, which may include dedicated sizing charts for their equipment. These take precedence over general code tables.

Engineering Calculations

For complex or unusual installations, engineering calculations may be required. These consider factors like draft requirements, flow resistance, and temperature profiles.

Computer Programs

Specialized software is available for vent sizing, particularly for complex commercial and industrial applications. These programs can model system performance under various conditions.

Vent Installation Best Practices

Follow Instructions

Always follow manufacturer's installation instructions for both the appliance and venting components

Maintain Proper Slope

Horizontal sections should slope upward away from the appliance at least 1/4 inch per foot

Provide Adequate Support

Use proper supports at specified intervals to prevent sagging and maintain clearances

Seal Joints Properly

Use approved methods and materials for joining vent sections

5

Maintain Clearances

Ensure proper clearances to combustible materials are maintained throughout the system

Vent Inspection Procedures

Visual Examination

Check for proper installation, support, slope, and clearances

Joint Inspection

Verify all joints are properly connected and sealed where required

Clearance Verification

Confirm proper clearances to combustible materials throughout the system

Termination Check

Ensure proper termination location and clearances from building openings

Draft Testing

Verify proper draft and absence of spillage under normal operating conditions

Draft Testing Methods

Draft Gauge Measurement

A draft gauge or manometer can be used to measure the pressure in the vent connector or at the draft hood. This measurement should be compared to manufacturer's specifications to verify proper operation.

Smoke Test

A smoke pencil or match can be used to check for proper draft at the draft hood. Smoke should be drawn into the draft hood opening, indicating proper draft. Any spillage indicates a potential venting problem.

Combustion Analysis

Modern combustion analyzers can measure draft along with other combustion parameters like oxygen, carbon monoxide, and efficiency. This provides a comprehensive assessment of appliance and venting system performance.

Air Requirements Overview

Combustion Air

Air needed for the actual burning of fuel

Dilution Air

Air that mixes with flue gases in draft hood

Building Pressure

Maintaining neutral or slightly positive pressure

Ventilation Air

Air for cooling and general ventilation

Air is required for the combustion process to meet three requirements: air for combustion (for every 1000 Btu produced by any fuel, 10 ft^3 of air is required, plus additional excess air), dilution air for the draft diverter, and air for ventilation. For every 1000 Btu (0.293 kW) produced by burning natural gas or propane, up to 30 ft^3 (0.84 m^3) of air may be required.

Air Supply Methods

Indoor Air

When the building has sufficient volume and air infiltration, indoor air may be used for combustion, dilution, and ventilation. This is known as using air from inside the building or "indoor combustion air."

Requirements:

- Building must have sufficient volume based on appliance input
- Adequate infiltration must be present
- No significant negative pressure conditions
- No competing exhaust systems that could cause depressurization

Outdoor Air

When indoor air is insufficient or when appliances are installed in confined spaces, outdoor air must be provided. This can be accomplished through:

- Direct openings to outdoors
- Vertical ducts
- Horizontal ducts
- Combination of methods
- Engineered systems

The size and configuration of openings depend on the appliance input and the method used.

Sizing Air Openings

Method	Opening Size Calculation	Notes
Two Permanent Openings Method	1 sq in per 4,000 Btu/h (vertical ducts) 1 sq in per 2,000 Btu/h (horizontal ducts)	One opening within 12 in of ceiling, one within 12 in of floor
One Permanent Opening Method	1 sq in per 3,000 Btu/h	Opening must be within 12 in of ceiling
Mechanical Air Supply	0.35 CFM per 1,000 Btu/h	Must include controls to operate with appliance

These sizing requirements are based on the total input of all appliances in the space. Different codes may have slightly different requirements, so always consult the applicable code for your jurisdiction.

Air Requirements for Large Equipment

Equipment Over 400 MBtu/h

Requires special consideration and often engineered solutions

Commercial Applications

May need dedicated mechanical ventilation systems

Engineered Systems

Designed specifically for the application and equipment

Code Requirements

Must comply with specific provisions for large equipment

For equipment with inputs over 400 MBtu/h, standard sizing tables and methods may not be sufficient. These installations often require engineered systems designed by qualified professionals to ensure adequate air supply and proper venting.

Negative Pressure Concerns

Modern Construction

Tighter building envelopes reduce natural infiltration

Exhaust Systems

Range hoods, clothes dryers, and exhaust fans remove air

Negative Pressure

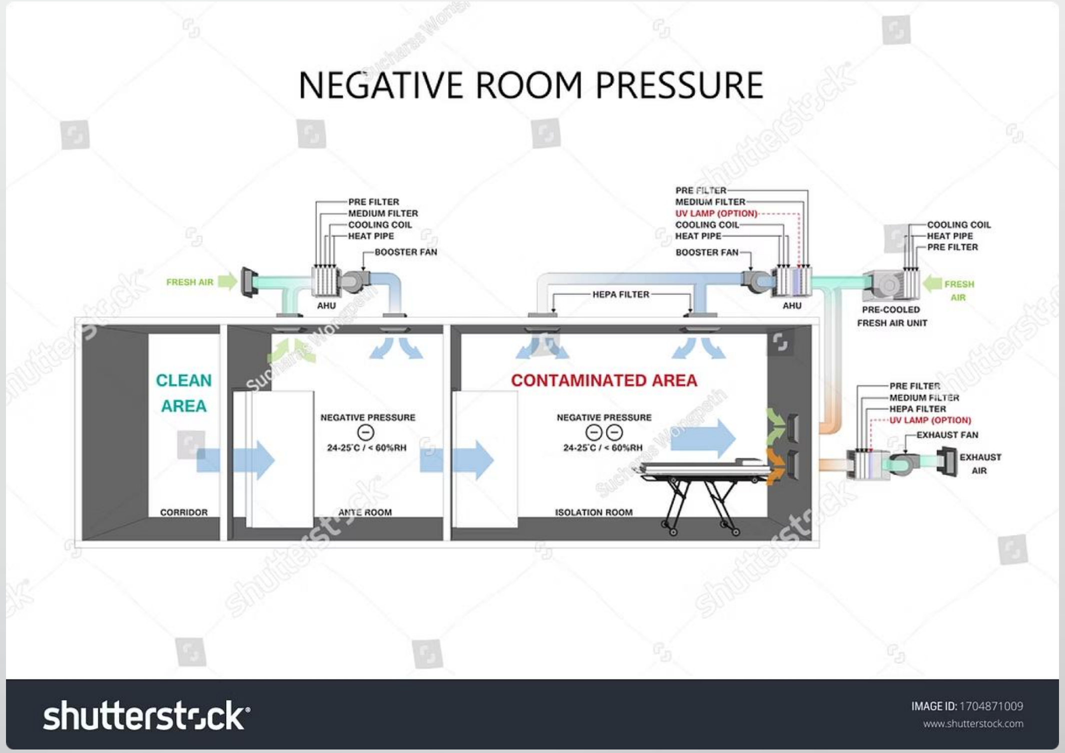
Can exceed 0.02 inch w.c. (5 Pa) in some conditions

4

Appliance Spillage

Natural draft appliances may spill combustion products

Even more additional air may have to be provided to compensate for the operation of range hoods, clothes dryers, and exhaust fans, which can cause a negative pressure condition in the building. A negative pressure of more than 0.02 inch w.c. (5 Pa) can cause natural draft appliances (those with draft control devices) to spill the products of combustion into the building.



Direct Vent Systems

Definition and Operation

Direct vent systems draw combustion air directly from outdoors and vent combustion products directly outdoors through a sealed system. This approach isolates the combustion process from the indoor environment, providing several advantages:

- Not affected by indoor air quality or pressure
- Can be installed in confined spaces without additional air openings
- Improved safety by reducing risk of combustion product spillage
- Enhanced efficiency by using outdoor air for combustion

Installation Considerations

When installing direct vent systems:

- Follow manufacturer's instructions precisely
- Use only approved venting components
- Maintain proper clearances at termination
- Ensure proper slope for condensate drainage
- Seal all joints according to manufacturer's requirements
- Consider wind and snow effects on termination location

Power Venting Systems

External Power Venters

Installed at the termination point of the vent system, these devices create mechanical draft to overcome resistance in the vent system. They allow for longer vent runs and can enable sidewall venting for appliances that would otherwise require vertical venting.

Induced Draft Blowers

Integrated into the appliance, these fans are located between the heat exchanger and the vent connection. They pull combustion products through the heat exchanger and push them into the vent system, creating positive pressure in the vent.

Integrated Power Vent Appliances

Many modern appliances come with built-in power venting systems designed specifically for the appliance. These integrated systems are engineered to provide optimal performance and safety.

Troubleshooting Venting Issues

Spillage at Draft Hood

Possible causes: blocked chimney, inadequate draft, downdraft, negative building pressure, improper vent sizing, or disconnected vent.

Solutions: Check for blockages, verify proper sizing, ensure adequate air supply, check for competing exhaust systems.

Condensation in Vent

Possible causes: oversized vent, long horizontal runs, uninsulated vents in cold spaces, low flue gas temperature.

Solutions: Properly size vent, insulate where needed, minimize horizontal runs, consider liner for masonry chimney.

Corrosion of Vent Materials

Possible causes: condensation, improper materials for application, mixing of different metals.

Solutions: Use appropriate materials for the appliance category, ensure proper slope for drainage, address condensation issues.

Noise in Venting System

Possible causes: improper sizing, excessive draft, loose connections, thermal expansion.

Solutions: Verify proper sizing, check connections, install draft control if needed, ensure proper support.

Safety Considerations

Carbon Monoxide Hazards

Improper venting can lead to carbon monoxide entering living spaces

Fire Risks

Inadequate clearances to combustible materials can cause fires

Detection Systems

CO detectors should be installed in all buildings with fuel-burning appliances

Regular Inspection

Venting systems should be inspected annually by qualified technicians

Occupant Education

Building occupants should understand warning signs of venting problems

Code Compliance

Canadian Codes

In Canada, gas installations must comply with:

- CSA B149.1 Natural Gas and Propane Installation Code
- Provincial and territorial modifications to the national code
- Local municipal requirements

The CSA B149.1 code contains specific requirements for venting systems, including sizing, materials, clearances, and termination locations.

Key Compliance Areas

Critical areas of code compliance for venting systems include:

- Proper appliance categorization
- Appropriate vent materials for the application
- Correct sizing methodology
- Required clearances to combustible materials
- Proper termination locations and clearances
- Adequate support and slope
- Proper air supply for combustion and ventilation

Emerging Technologies

Ultra-High Efficiency Systems

New appliances with efficiency over 95% require specialized venting solutions

Advanced Materials

New plastic and composite venting materials for condensing appliances

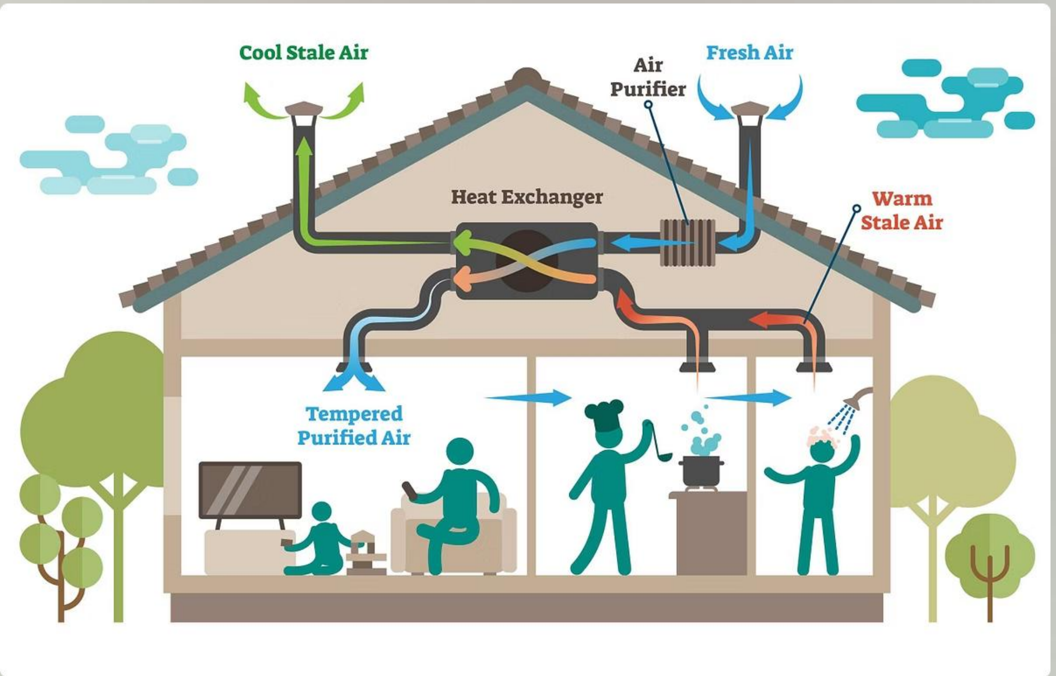
Smart Venting

Electronically controlled venting systems that adjust to conditions

Modulating Systems

Venting systems that adapt to changing appliance firing rates

The field of venting technology continues to evolve with new materials, designs, and control systems. Gas technicians must stay current with these developments to properly install and service modern equipment.



Professional Development

Initial Training

Gas technicians receive foundational knowledge through formal education programs

Certification

Licensing and certification requirements ensure minimum competency

Continuing Education

Ongoing learning keeps technicians current with changing technologies and codes

Specialization

Advanced training in specific areas like high-efficiency systems or commercial applications

Red Seal Certification

National standard for gasfitters provides recognition of skills across Canada

Documentation and Record Keeping

Installation Records

Detailed documentation of venting system components, sizing calculations, and installation details should be maintained for each installation.

Inspection Reports

Regular inspection findings, including draft measurements, spillage tests, and visual observations, should be documented and retained.

Maintenance Logs

Records of cleaning, repairs, and component replacements help track system history and identify recurring issues.

Compliance Verification

Documentation that demonstrates compliance with applicable codes and standards protects both the technician and the customer.

Proper documentation is essential for ensuring safety, demonstrating code compliance, and providing a reference for future service or troubleshooting. It also serves as protection for the technician in case of disputes or liability issues.

Customer Education

Warning Signs

Educate customers about signs of venting problems: odors, moisture on windows, CO detector activation

Maintenance Schedule

Explain the importance of regular inspection and maintenance of venting systems

Home Modifications

Warn about how renovations can affect venting: adding exhaust fans, sealing the building envelope

Safety Devices

Emphasize the importance of CO detectors and explain their proper placement and testing

Emergency Procedures

Provide clear instructions on what to do if venting problems are suspected

Chapter Summary

Appliance Categories

Understanding the four categories of vented appliances

Draft Principles

Natural and mechanical draft fundamentals

System Components

Venting materials and accessories for different applications

Installation Practices

Proper techniques for safe and effective venting

Air Requirements

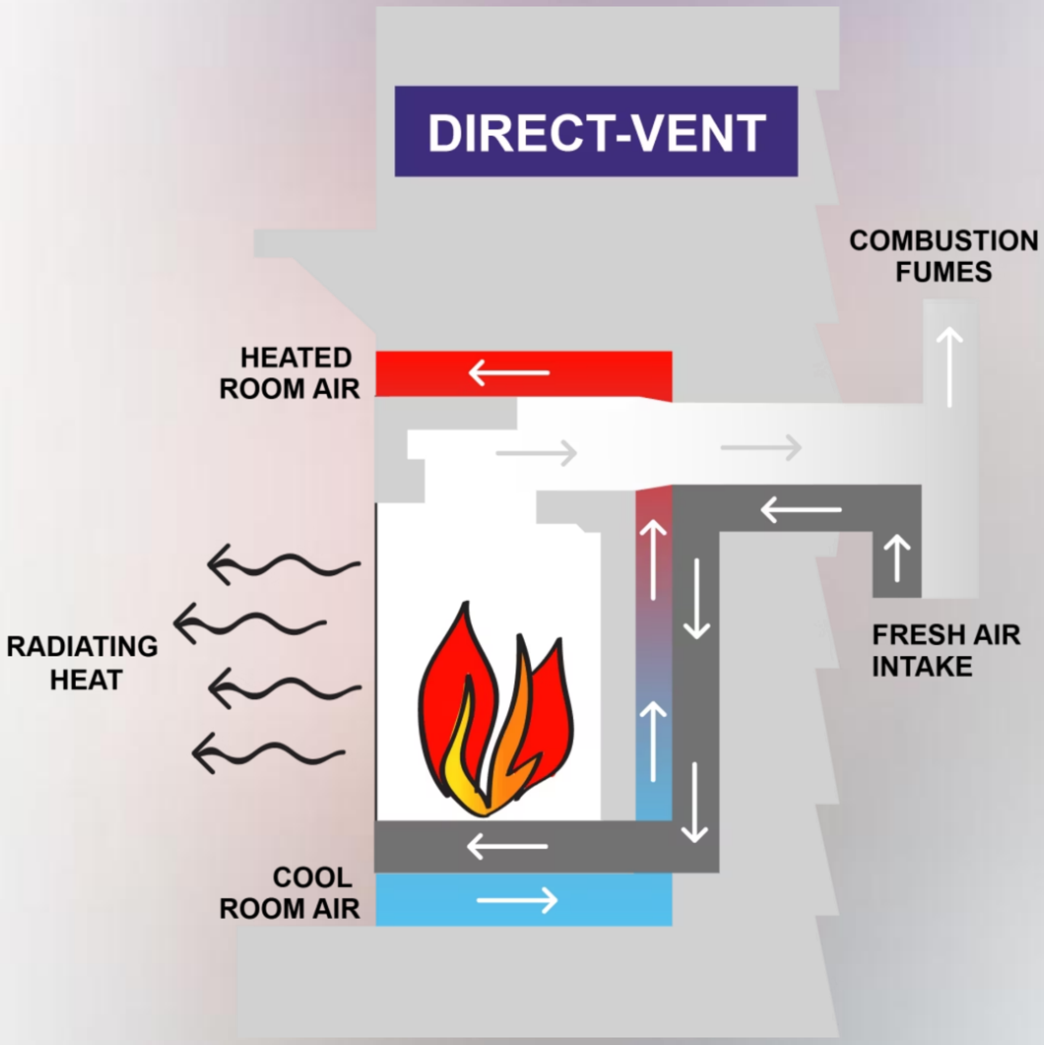
Ensuring adequate air for combustion, dilution, and ventilation

Gas technicians/fitters must be thoroughly familiar with the operating features of gas-fired appliances and how such appliances are categorized so that venting systems and system components match an appliance's particular requirements. Their relationship to the fundamental principles of draft is essential for safe and efficient installation and service.

CSA Unit 22

Chapter 2
Vent Installation and Assembly

The assembly and installation of each venting system is unique. Gas technicians/fitters must consider factors such as the appliance type, the number of appliances, the type of building, and the location of the appliances in the building before installation can begin.



Purpose of Venting Systems

Appliance Type Considerations

Different appliances require specific venting systems based on their category and operational characteristics.

Building Factors

The type of building and location of appliances within it significantly impact venting system design and installation.

Installation Complexity

Venting installations may be simple and straightforward or difficult and time consuming depending on various factors.

Learning Objectives

Describe vents and their components

Understand the various types of vents and how their components function together in a venting system.

Describe chimneys and liners

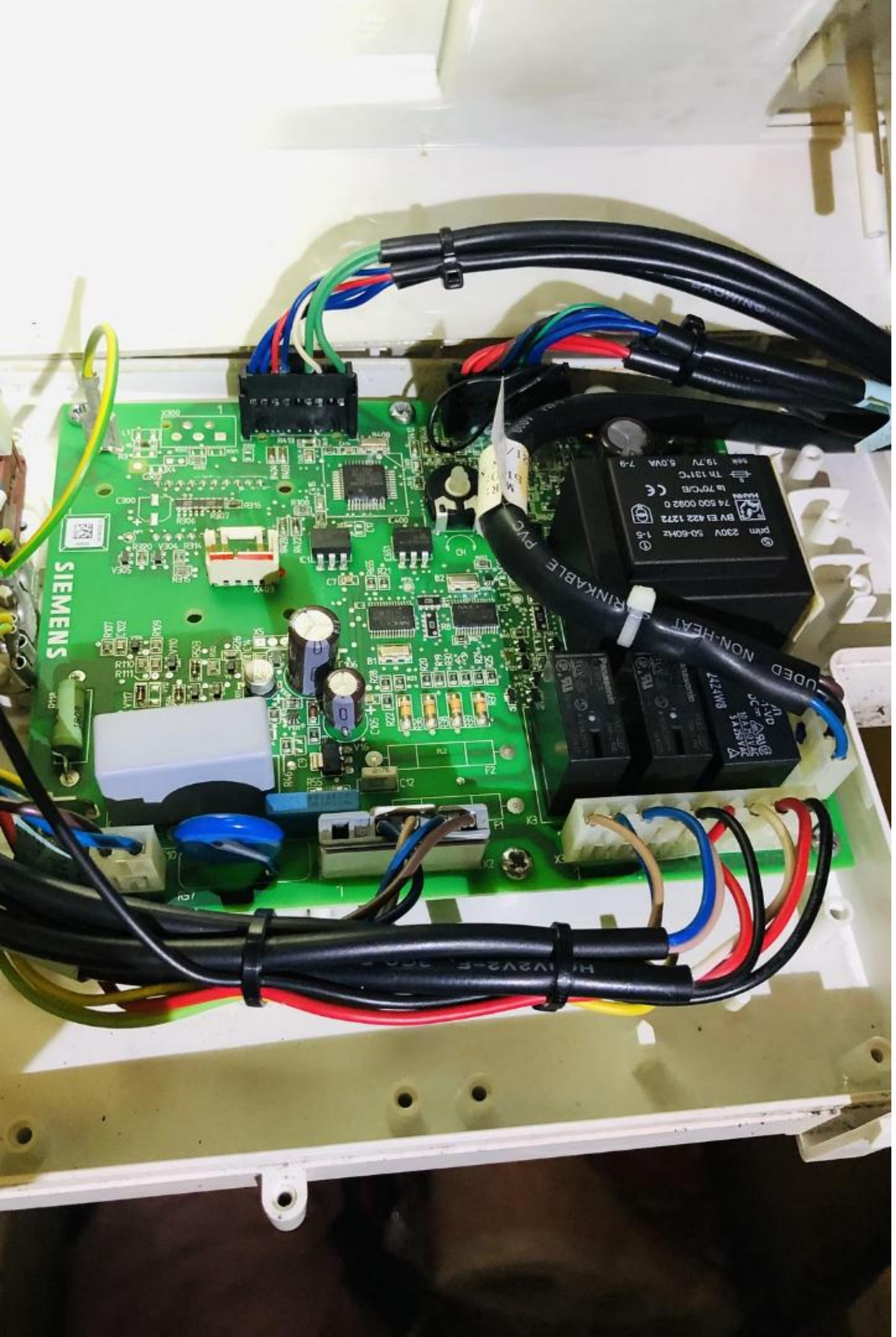
Learn about different chimney types and the liners used to ensure proper venting.

Describe vent and chimney terminations

Understand the requirements for proper termination of vents and chimneys.

Key Terminology

Term	Abbreviation (Symbol)	Definition
Dead air space		Insulating space
Special venting system		A venting system certified with the appliance and either supplied or specified by the appliance manufacturer
Type BH vent		A vent complying with ULC S636 and consisting entirely of factory-made parts, each designed to be assembled with the others without requiring field fabrication, and intended for venting gas appliances



Factors Affecting Vent Installation

Appliance Category

The category of the appliance determines the type of venting system required.

Number of Appliances

The number of appliances to be vented affects the design and capacity of the venting system.

New vs. Replacement Installation

Whether it is a new installation or a replacement appliance impacts venting decisions.

Appliance Differences

Whether the replacement appliance is a different category or operates on a different fuel or input rate than the original.

Understanding Downdraft

What is a Downdraft?

A condition in which a draft is forced downward and can cause flue gas spillage.

Causes of Downdraft

Can be caused by wind conditions, improper vent termination, or pressure differentials within the building.

Dangers of Downdraft

Downdrafts can lead to dangerous spillage of combustion products into living spaces.

Natural Draft Explained

Heat Generation

Combustion creates hot gases in the appliance

Temperature Difference

Hot gases are less dense than surrounding air

Upward Movement

Hot gases rise through the vent system

Negative Pressure

Creates a negative pressure that draws in combustion air

Natural draft is produced by the upward movement of hot gases creating a negative pressure.

Theoretical Draft Calculation

$$D = \frac{H(T_s - T_o)}{T_s + T_o}$$

The formula for calculating theoretical draft involves the height of the vent (H), the stack temperature (T_s), and the outdoor air temperature (T_o).

Height Factor

Taller vents produce stronger draft.

Temperature Differential

Greater difference between stack and outdoor temperatures increases draft.

Optimal Conditions

Highest stack temperature, lowest outdoor air temperature, and highest vent produce the greatest draft.

Stack Temperature Considerations

Average Stack Temperature

The average stack temperature is the average between the temperature at the flue collar and the temperature at the vent termination.

This is an important factor in calculating draft and ensuring proper venting system operation.

Factors Affecting Stack Temperature

- Appliance efficiency
- Vent material and insulation
- Length of vent system
- Ambient temperature
- Appliance firing rate

Heat Extraction from Flue Gases

Heat Reclaimer

A device installed to extract heat from flue gases, improving overall system efficiency.

Heat Exchanger

Transfers heat from flue gases to another medium without mixing the two.

Heat Recovery Unit

A system designed to capture and utilize waste heat from flue gases.

These devices help improve energy efficiency by capturing heat that would otherwise be lost through the venting system.

Vent System Capacity

Maximum Capacity

Each vent system has a maximum capacity related to flow. Exceeding this capacity can lead to improper venting and potentially dangerous conditions.

Minimum Capacity

Each vent system also has a minimum capacity related to temperature. If the system operates below this capacity, condensation and other issues may occur.

Understanding both the maximum and minimum capacities of a venting system is crucial for proper installation and safe operation.

Vent Height Limitations

Limited Benefits

There is a limit to the benefits gained by increasing the vent height.

Diminishing Returns

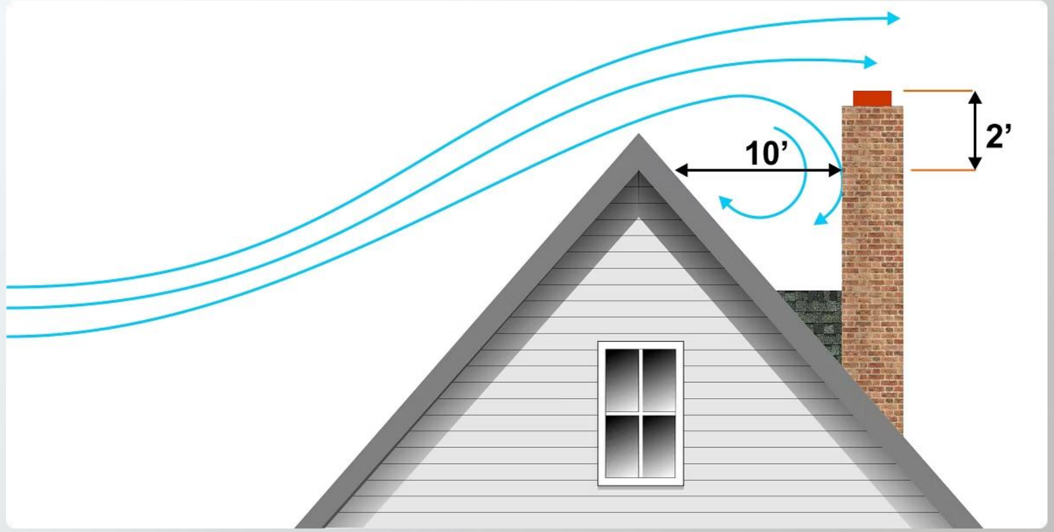
After a certain point, adding height provides minimal additional draft improvement.

Structural Considerations

Excessively tall vents may require additional structural support and can be subject to greater wind forces.

Cost Factors

Taller vents increase installation costs without proportional performance benefits beyond certain heights.



Building Considerations for Venting

Building Type Impact

The type of building significantly affects venting system design and installation. In many buildings, the route of the venting system is predetermined and factored into the design.

Multi-Story Buildings

In buildings of more than one-storey, a pipe chase is often built in and centrally located to carry venting and other piping from the ground floor or basement to the roof.

Concealed Venting

In situations that require the vent piping to be installed, the area is framed in and the venting concealed. In the case of a BW vent, it is installed in the wall cavity and concealed.

Special Venting Systems

Certified Systems

Most vents and components that the gas technician/fitter is likely to install are special venting systems that use one of the many types of BH vent materials.

Installation Instructions

Instructions for installing these systems are found in the appliance manufacturer's and the vent manufacturer's certified installation instructions.

Varied Requirements

These instructions are as varied as the manufacturers' products and require the installer to carefully read and comply with the requirements given.

Focus on Natural Draft Systems

Main Focus

Although this chapter covers BH vents and some common aspects of their installation, its main focus is on natural draft vent systems.

Critical Decisions

Natural draft system installation requires the gas technician/fitter to make crucial decisions based on an understanding of the venting system and the numerous code requirements applicable to natural draft venting systems.

Other Venting Awareness

The gas technician/fitter must be aware of the conditions pertaining to the installation of other vents and venting situations.

Installation Considerations

Clearances from Combustibles

Whatever route or type of venting you use, you must consider conditions such as clearances from combustibles.

Firestop Requirements

Proper firestops must be installed where vents pass through floors, ceilings, or walls.

Support Requirements

Adequate support must be provided for the venting system to maintain integrity and proper clearances.

Termination Location

The location and height of vent and chimney terminations can impair venting effectiveness if not properly installed.

Clearance Requirements

When installing vents and/or vent connectors, clearances from combustibles must always conform to the distances and clearance reductions itemized in CSA B149.1, Tables 8.6 and 8.7.

Appliance connector	Type B vent connector	Other than Type B vent connector
Boiler	1 (25)*	6 (150)*
Warm-air furnace	1 (25)*	6 (150)*
Service water heater	1 (25)*	6 (150)*
Space heater	1 (25)*	6 (150)*
Floor furnace	3 (75)†	9 (225)

* Except as otherwise certified.

† 3 in (75 mm) for a distance of not less than 3 ft (900 mm) from the outlet of the draft hood. Beyond 3 ft (900 mm), the minimum clearance shall be 1 in (25 mm).

Types of Vents

Single-wall vent (Type C)

Simple vent type made of galvanized steel.

Certified gas vents (Type B)

Includes L-vent and BW types with double-wall construction.

Factory-built chimneys (Type A)

Designed for higher temperature applications.

Canopies

Used in commercial applications for certain appliances.

Special venting systems (Type BH vents)

Used for specific appliance categories with unique requirements.

Single-Wall Vent (Type C)

Characteristics

Available in various lengths, gauges, and diameters, the single-wall vent (Type C vent) is the simplest to install. It can be cut to suit the measurements required, and the ends can be field crimped with a crimping tool.

Single-wall vents are made of a single wall of galvanized steel. Three screws, positioned 120° apart, secure sections at each joint.

Available Fittings

- Tees
- Wyes
- Reducers
- Adjustable elbows

Limitations

Not being insulated, single-wall vents may not penetrate floors, ceilings, or concealed areas of the building structure.

Wall Penetration Requirements

Thimble Requirement

A single-wall vent may penetrate a wall, provided the wall is protected by a ventilated metal thimble that is two inches larger than the vent or vent connector.

Code Compliance

This requirement is specified in Clause 8.18.12 in CSA B149.1.

Purpose

The thimble provides protection for combustible wall materials from the heat of the vent pipe.

Vent Connector Gauge Requirements

Type of vent connector	Size	Gauge
Connector with draft-hood	3 - 5 inches	28 GSG
Connector with draft-hood	Over 5 - 8 inches	26 GSG
Connector with draft-hood	Over 8 - 16 inches	24 GSG
Connector with draft-hood	Over 16 - 30 inches	20 GSG
Connector without draft dilution	All sizes	24 GSG
Connector for an incinerator	All sizes	20 GSG

The minimum galvanized steel gauges vary with the diameters of the vent connectors, as specified in Clause 8.18.3 of CSA B149.1.

Type B Vent Characteristics

Certification

Certified to CAN/ULC-S605, Standard for Gas Vents or an equivalent standard.

Factory-Made Parts

Made up of factory-made parts, each designed to be assembled without the need for field fabrication.

Appliance Compatibility

Used with appliances certified for use with Type B vents.

Construction

A double-wall vent with a dead air space (insulating space) between the walls.

No Field Cutting

Not designed to be field cut.

Type B Vent Components

Available Lengths

B vents are available in pre-cut lengths from 6 to 60 inches, depending on the diameter.

B vents have open-end sleeves available for length adjustment.

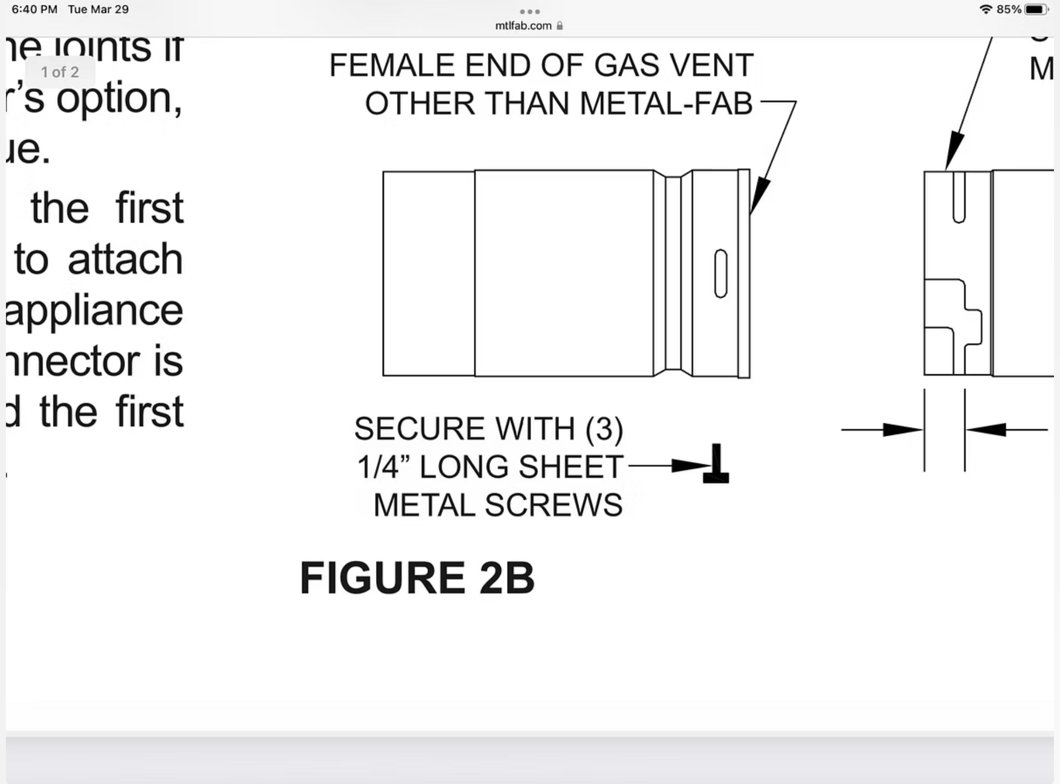
Available Fittings

- Tees
- Wyes
- Adjustable 90° and 45° elbows
- Single-wall vent adapters

B-vent pipe and fittings are connected with a twist lock procedure.

Note that a base fitting for a Type B vent must be accessible for inspection.

Type B Vent Construction



Materials

B-vents are constructed of non-combustible, corrosion-resistant material.

Inner Wall

They have an aluminum inner wall that can withstand vent gas temperatures to a maximum of 470°F (243°C).

Usage Restrictions

As specified in Clause 8.10.7 of CSA B149.1, you may only use Type B vents to vent gas appliances with draft-hoods or diverters.

Additional Allowance

You may also use them for appliances without draft control devices, provided that the appliance has certification for use with a Type B vent.

Category I Appliances

Certification

The conditions for using Type B vents are also satisfied if the appliance has been certified and marked Category I.

Sizing Importance

Since the insulating quality of a Type B vent is less than that of a factory-built insulated metal chimney, sizing B-vents is a must to avoid excess temperatures when installed in wood frame construction.

Clearance Requirements

The minimum clearance from combustibles is designated in Table 8.6 of CSA B149.1.

Outdoor Vent Installation

1

Certification Requirement

When a double-wall vent cannot be practically installed inside a building, it may be installed outdoors if it is certified for outdoor installation.

2

Installation Instructions

It must be installed in accordance with the manufacturer's certified installation instructions.

3

Continuity Requirement

The double-wall vent must be continuous from the vent cap to the appliance draft-hood or flue collar outlet.

4

Enclosure Requirement

The outdoor vent below the roof line must be enclosed and may be required, under the manufacturer's certification, to have the enclosure insulated.

Type BW Vent

Construction

Type BW vents are similar in construction to Type B vents, but are oval in cross-section. They are designed specifically for installation in walls for venting recessed wall furnaces.

Certification

Type BW vents must be certified under the CAN/ULC-S605, Standard for Gas Vents, or equivalent standards, and requirements apply to all components of the venting system.

Assembly

They consist entirely of factory-made parts, each designed to be assembled without the need for field fabrication. The vent is connected with a snap-lock procedure.

Since the development of side-wall vented appliances, Type BW vents are no longer commonly used.

Type L Vent

Higher Grade

Type L vents are often described as a higher grade double wall vent compared to Type B vent.

Temperature Rating

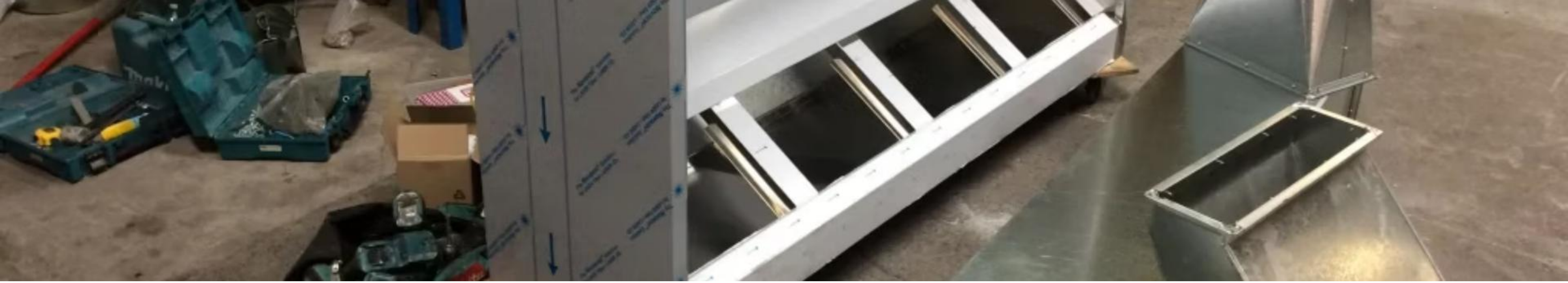
Type L vent can withstand a higher flue gas temperature than Type B vent. Maximum vent gas temperature is 550°F (288°C).

Applications

They are used with appliances certified for use with Type L vents (usually oil-fired appliances), as well as in place of Type B vents.

Certification

Type L vents are certified under ULC Standard S609, Low temperature vents, Type L; the requirements of this Standard apply to all components of the venting system.



Canopy Venting

Application

As specified in Clause 8.30 of CSA B149.1, you may vent an appliance through an exhaust canopy installed in other than a dwelling unit if specific conditions are met.

Code Compliance

The canopy must comply with the requirements of the applicable codes, including CSA B149.1, the NBC, and the National Fire Code of Canada.

Exhaust Volume

The exhaust volume of the canopy must be sufficient to provide for capture and removal of grease-laden vapours and products of combustion.

Appliance Requirements

The appliance must have an input not exceeding 400 MBtu/h (120 kw) and its flue outlet must be directly under the canopy.

Canopy Interlock Requirements

Interlock Requirement

The appliance must be interlocked with the exhaust so that it can operate only when exhaust air flow is proven.

This ensures that combustion products are properly removed and don't accumulate in the space.

Exceptions to Interlock Requirement

- A booster water heater with an input of 50 MBtu/h (15 kw) or less that supplies water to an automatic dishwasher
- An appliance approved to ANSI Z83.11/CSA 1.8

Most cooking appliances that would normally be installed under a canopy are approved to ANSI Z83.11/CSA 1.8 and, therefore, would not normally be interlocked with the exhaust fan.

Special Venting Systems Defined

Type BH Vent

A vent complying with ULC S636 and consisting entirely of factory-made parts, each designed to be assembled with the others without requiring field fabrication, and intended for venting gas appliances.

Special Venting System

A venting system certified with the appliance and either supplied or specified by the appliance manufacturer.

Application

Gas technicians/fitters must employ Type BH vent or special venting systems on all Category II, III and IV appliances.

BH Vent Certification

Interchangeable Terms

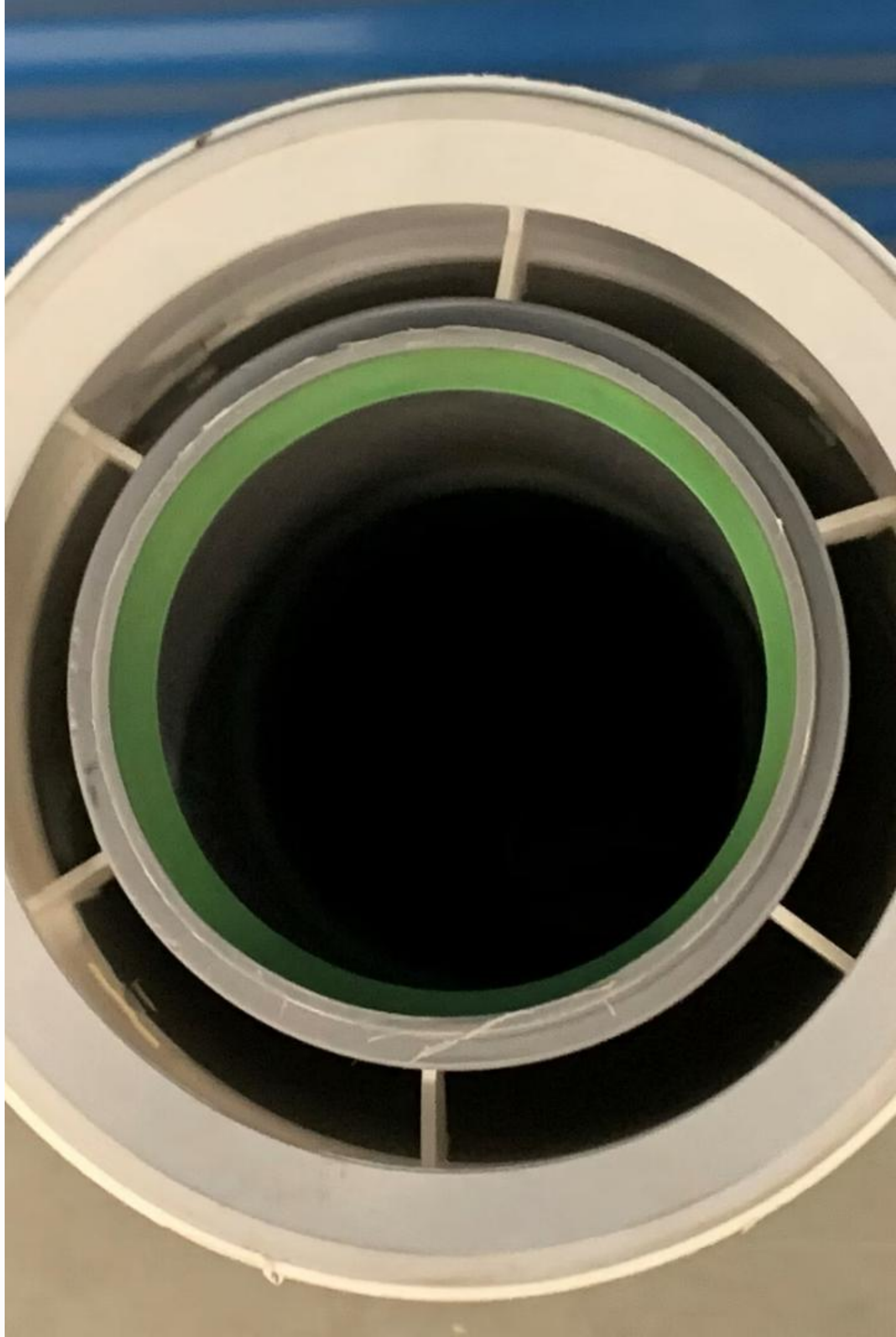
Although "Type BH Vent" and "special venting system" are commonly used interchangeably, some metallic types of special venting systems may have approval for use with only the specific appliance.

ULC S636 Certification

All BH vents - both metallic and non-metallic - are certified to ULC S636 and are considered special venting systems.

Code Requirement

Since January 2007, Clause 8.9.6 of CSA B149.1 requires that vents constructed of plastic piping shall be certified to ULC S636.



BH Venting System Materials

Stainless Steel

Used for higher temperature applications.

PVC

Used for lower temperature applications.

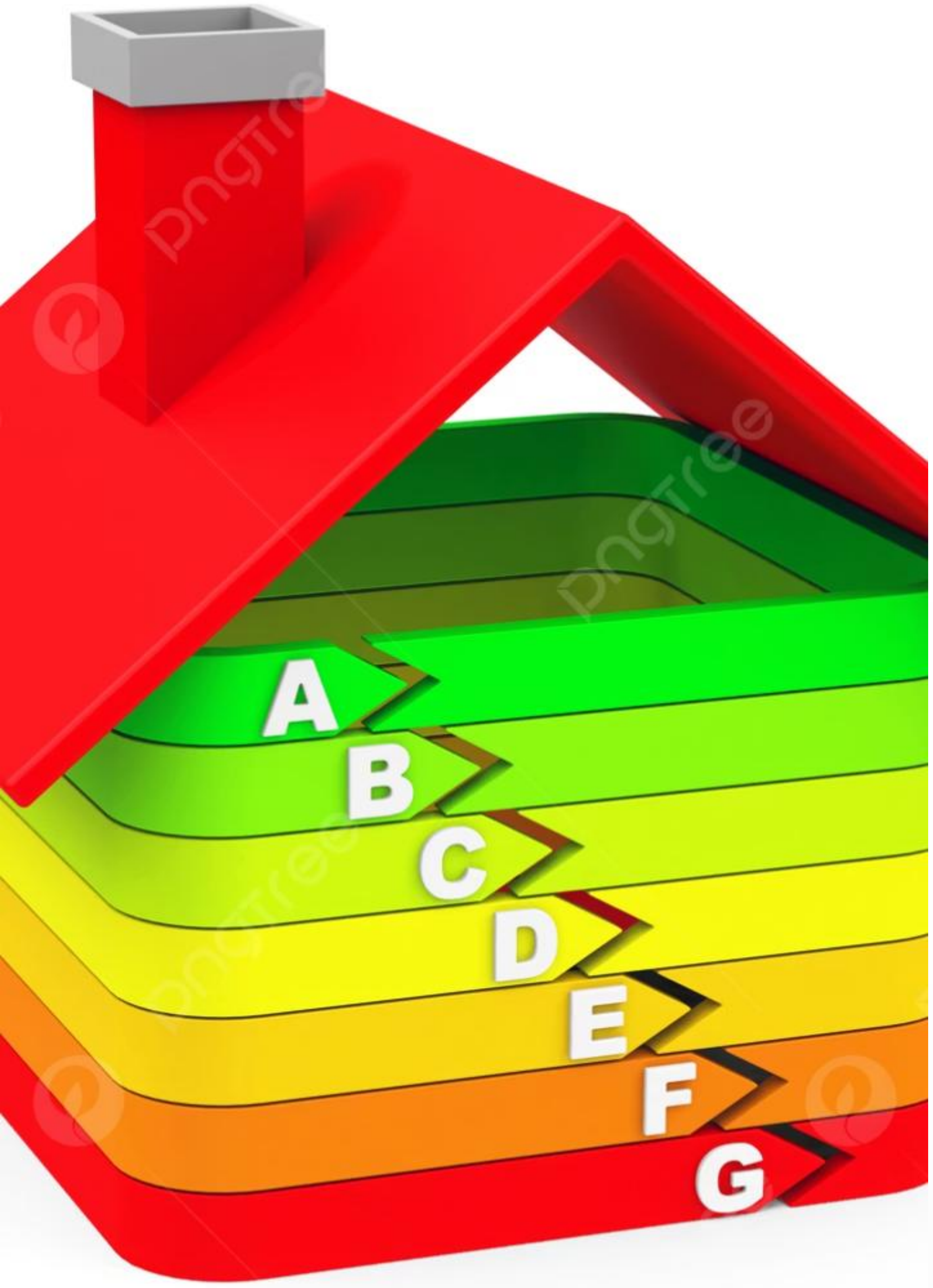
CPVC

Used for medium temperature applications.

Polypropylene

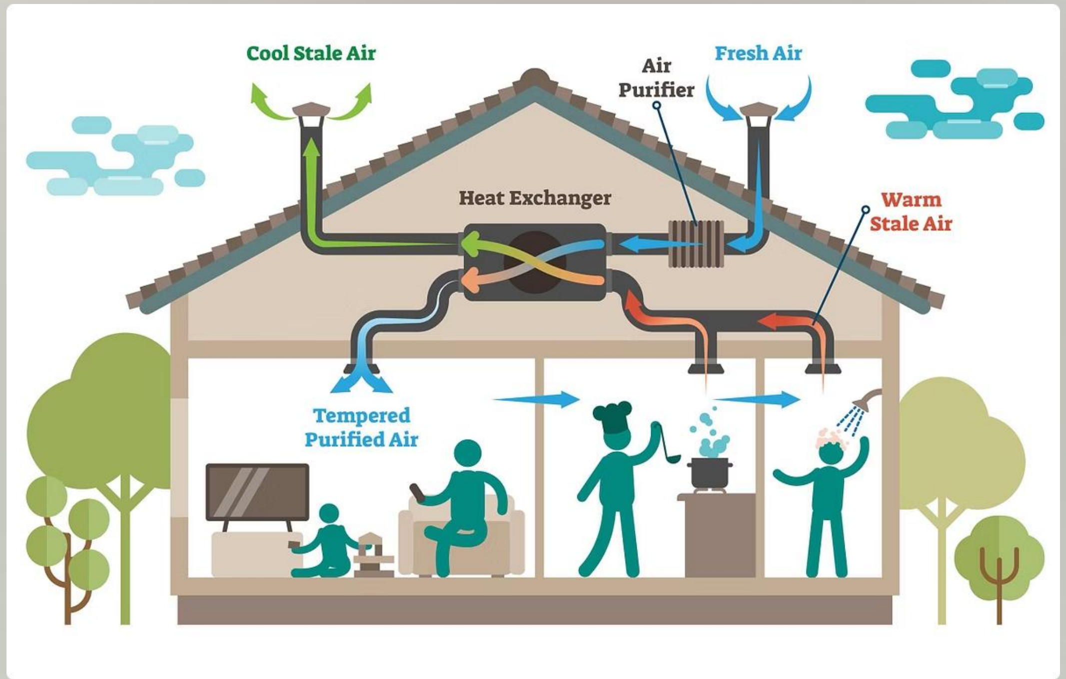
Used for medium-high temperature applications.

Type BH venting systems are typically made from these materials, with each having specific temperature ratings and applications.



ULC S636 Temperature Classifications

Classification	Temperature Rating	Typical Material
Class I	More than 275°F (135°C) but less than 470°F (245°C)	Stainless Steel
Class II A	Up to and including 149°F (65°C)	PVC, white with blue writing
Class II B	Up to and including 194°F (90°C)	CPVC, grey
Class II C	Up to and including 230°F (110°C)	Polypropylene, light grey
Class II D	Up to and including 275°F (135°C)	Stainless steel



Special Venting System Installation

Manufacturer Specifications

The manufacturers of the appliance and vent system largely determine the size, location, installation methods, and type of material employed in special venting systems.

Varied Procedures

Manufacturers use different vent materials and have different installation procedures.

Consultation Requirement

Consult all applicable codes and certified manufacturer's instructions for safe and efficient installation of these types of venting systems.

Brand Compatibility

It is imperative that the appliance manufacturer lists a given brand of BH venting as acceptable on a specific appliance.

BH Vent Component Compatibility

No Mixing of Components

Different BH vent manufacturers have different joint systems and adhesives. Do not mix pipe, fittings or joining methods from different manufacturers.

Multiple Venting Options

Some gas appliances may have approval for venting with more than one class of BH vent, as well as concentric or two pipe direct vent options.

Starter Adapters

Typically the appliance manufacturer supplies the starter adapter to ensure proper connection between the appliance and the venting system.

Detailed Instructions

With all of these venting options, manufacturers' vent installation instructions have become more detailed than the general installation instructions to the point that they are often a separate manual.

S636 Plastic Vent Systems

Historical Development

Plastic venting products have facilitated sidewall vented gas installations for many years. However, over the years, the industry has used certain plastic products in gas venting with varying degrees of success.

The need to produce a plastic venting standard against which the industry could test products became evident amid findings that ABS and PVC plastic fracture and distort with heat exposure over time. The result was the development and acceptance of ULC S636.

Applications

Type BH plastic vents usually work with high-efficiency appliances that produce low flue temperatures and positive vent pressures (Category IV).

The low flue temperatures create abundant water vapour, and thus manufacturers must make the venting system out of corrosion-resistant and leak proof material.

In some cases, Type BH plastic vent work with appliances that introduce a high proportion of dilution air to cool the flue gases before entering the plastic vent.

Plastic Vent Installation Considerations

Manufacturer's Instructions

The appliance manufacturer's instructions provide information on required sizing, allowable lengths, and allowable number of fittings since this information depends on the appliance features.

Fire-Rated Penetrations

If the plastic BH vent must penetrate a fire-rated wall or ceiling, be sure to use an approved listed penetration assembly.

Air Supply Piping

The requirement for vents that use plastic piping to be certified to ULC S636 applies only to the vent pipe. The appliance manufacturer's instructions usually specify the air supply pipe material.

Compliance Requirements

Check with the manufacturer and comply with all applicable requirements concerning sizing, joining, and supporting the plastic air supply piping.

PVC Vent Systems

636 PVC

- Classified as Type BH Class II A vent
- Suitable for use on appliances with flue gas temperatures up to and including 65°C (149°F)
- White in colour

636 CPVC

- Classified as Type BH Class II B vent
- Suitable for use on appliances with flue gas temperatures up to and including 90°C
- Grey in colour

There are two types of PVC venting systems that are certified to ULC S636.

PVC Vent Joining Materials

Specialized Cement

Each manufacturer of S636 PVC vent has solvent cement that is specifically formulated and certified for flue gas venting applications.

Transition Cement

Transitioning between venting materials and connection to ABS appliance connectors require the use of specialized transition cement.

Primer Requirements

Primer may be a requirement for applications where the gas venting system is to be installed in cold temperatures. It is always a requirement for 6 inch and 8 inch piping systems and for all installations performed at temperatures of 0°C or less.

Local Regulations

Some jurisdictions have mandated primer use regardless of temperature (e.g., Alberta). Check with your local authorities.

PVC Vent Installation Process

Preparation

Obtain proper materials for job (proper cement and applicator for the size of piping system to be assembled). Cut pipe as square as possible using a hand saw and mitre box or mechanical saw. Remove all burrs from both the inside and outside of the pipe with a de-burring tool.

Dry Fit and Priming

Check pipe and fittings for dry fit before cementing. For proper interference fit, the pipe must go easily into the fitting 1/3 to 2/3 of the way. Apply primer to both the fitting socket and the pipe end, aggressively working the surfaces until softened.

Cement Application and Assembly

Apply cement to both surfaces, first to the pipe end and then to the fitting socket. Immediately assemble while cement is still wet, using sufficient force to ensure the pipe bottoms in the fitting socket. Twist the pipe a quarter turn during insertion.

Finishing and Curing

Hold the joint for approximately 30 seconds to avoid push out. Remove excess cement with a rag. Allow proper set and cure time according to manufacturer's instructions before testing or using the system.

PVC Vent Set and Cure Times

Temperature	Set Time (1-1/2" to 2")	Set Time (2-1/2" to 8")	Cure Time (1-1/2" to 2")	Cure Time (2-1/2" to 8")
60°C (140°F)	5 min	30 min	15 min	1 hr
40°C (104°F)	5 min	30 min	15 min	1 hr
20°C (68°F)	10 min	1 hr	20 min	2 hrs
10°C (50°F)	15 min	24 hrs	1 hr	48 hrs

Notes:

1. Initial set schedule is the necessary time to allow before the joint can be carefully handled.

2. Joint cure schedule is the necessary time to allow before commissioning the system.

3. In damp or humid weather allow 50% more cure time.

Polypropylene Venting Systems

Classification

S636 Class IIC vent systems are made of polypropylene material suitable for use on appliances with flue gas temperatures up to and including 230°F (110°C).

Available Types

- Single wall
- Flex
- Concentric

Black UV resistant pipe is also available where terminations are exposed to sunlight.

Polypropylene venting systems offer several advantages including higher temperature ratings than PVC and simpler installation without cement.

Polypropylene Vent Installation

Connection Method

Push-fit connections joined pipes, with EPDM or Viton gaskets located in the sockets.

Installation Direction

Install pipes and components with their socket ends to the outlet and male ends to the appliance.

Slope Requirement

Elbows are 87° to give horizontal runs at least 3° slope for proper condensate drainage back to the appliance condensate trap.

Manufacturer Compatibility

Do not mix different manufacturers' products.

Support Requirements

Support vents 1 m horizontal, 2 m vertical, and at changes in direction.

Polypropylene Vent Cutting and Joining

Cutting Guidelines

- Select components to minimize cutting
- Where cutting is necessary, you can cut pipe sections to length at male end (non-socketed end)
- Make any cuts at right angles to the pipe
- You can bevel pipe for insertion into the adjoining socket to ease installation
- Deburr all field cuts
- Never cut bends and other pre-formed components

Joining Process

- Check that gasket is properly in place
- Mark insertion depth
- Lubricate seals and male parts of pipes as per manufacturer; use lubricant, soapy water, or water only
- Slip a locking band onto the male end of pipe
- Push male end of pipe into opening with light twisting movement

Polypropylene Flex Venting

Manufacturer Variations

For polypropylene flex venting material, some manufacturers have intermittent straight section for cutting and connecting.

Gasket Placement

Others use a gasket that places into first whole groove nearest the end.

Connection Method

The end is then inserted into an adapter with locking tabs.

Application

Flex venting is particularly useful for installations with offsets or where rigid pipe would be difficult to install.

ual Product Not Sho

S636 Metal Vent Systems

Applications

Numerous gas-fired appliances such as boilers and water heaters have certification for use with stainless steel venting products certified to ULC S636.

Usually, gas technicians/fitters use this type of venting on appliances with a positive vent pressure of less than 8 inches w.c. (1990 Pa) that may have flue gas temperatures exceeding those allowed for certified plastic vents.

Construction

Most Type BH metal vents utilize AL 29-4C® stainless steel of either single- or double-wall construction.

Sizes vary from 3 to 24 inches (7.5 to 600 mm) in diameter and are available in a multitude of lengths -- usually up to 10 feet (3 m) for rigid pipe and 20 feet (6 m) for flexible pipe.

Specialty certified components such as elbows, wall thimbles, termination tees, and drain traps complete the installation needs of most side-wall or vertical venting choices.

Metal BH Vent Joining

Gasket Verification

The female end of each stainless steel component incorporates a silicone sealing gasket. Gaskets must be in the proper position or flue gases could leak resulting in carbon monoxide poisoning.

Pipe Alignment and Connection

Align pipes and push them together as far as they will go to indent or at least 1.75 inches.

Clamp Tightening

Tighten gear clamp to a minimum torque of 40 in/lb and a maximum of 50 in/lb. Gear clamp is not required on a 6 inch system.

Proper Orientation

Proper pipe orientation is essential to achieve effective condensate flow. In most cases, the use of a flue collar adaptor is required to connect directly to the appliance. This adaptor will configure the vent orientation with the gasket end of pipe and fittings towards termination.

Note: Some flue collars may require the use of high temperature silicone sealant to make a positive pressure gas-tight seal.

Drainage Requirements for BH Metal Vents

Drainage Fitting Requirement

A drainage fitting is commonly required on the lowest section of BH metal vent.

Purpose

This fitting allows condensate that forms in the vent to be properly drained away.

Installation Location

The drainage fitting should be installed at the lowest point in the venting system.

Condensate Disposal

Condensate must be properly disposed of according to local codes, typically through a neutralizer before entering the drainage system.

Existing Unapproved Special Venting Systems

High Temperature Plastic Venting (HTPV)

Was approved at one time. However, users experienced significant field failures with its use, causing many jurisdictions to issue regulations and bulletins outlining additional requirements affecting HTPV systems.

ABS Pipe and Fittings

Acrylonitrile butadiene styrene pipe and fittings were commonly used before 2007.

Non-Certified PVC and CPVC

PVC and CPVC pipe and fittings not certified to ULC S636 were also common before 2007.

Local Regulations

The gas technician/fitter is responsible for becoming familiar with all applicable local regulations and bulletins regarding these systems.

Regulations for Non-Certified Plastic Vents

Non-Retroactive Requirement

Although the requirement to use plastic vents certified to ULC S636 has been in place since January 2007, it was not a retroactive requirement.

This means that existing installations with non-certified vents were generally allowed to remain in service.

Local Authority Direction

Local authorities having jurisdiction may have special advisories or bulletins related to the use, inspection, or repair of non-certified plastic vents.

Check with the local authority for direction on this issue.

Some manufacturers of high efficiency appliances are approved for common venting. In such cases, you would be allowed to use an existing common vent system.

Chimneys and Liners

Code Requirements

The Gas Codes, the NBC, and local Building Codes detail special requirements for masonry and metal chimneys because chimneys must be constructed to meet Building Code requirements for fire safety and structural integrity.

New Chimney Requirements

For new chimneys, the builder must meet these requirements under the applicable Building Code.

Installer Responsibilities

The installer (the gas technician/fitter) for both new and existing chimneys is responsible for examination of the chimney to ensure that it is properly lined and free of soot, creosote, or obstructions prior to connection.

Preparation Requirements

Cleaning and repair of the chimney (if required) must therefore precede connection.

Chimney Cleanouts

Purpose

All chimneys require a cleanout opening, which is an opening into the chimney to allow clearing of any built up debris.

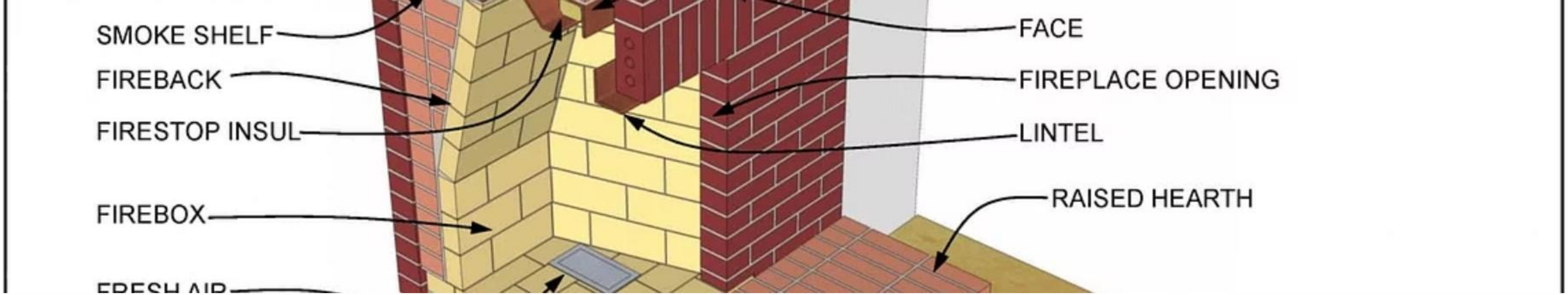
The cleanout is also used as an inspection point to assess the condition of the chimney and its freedom from debris or other buildup. Placing a mirror strategically in the cleanout enables inspection.

Location

The location of the cleanout should be as far below the vent connector as possible to lower the risk of debris blockage in the vent connector.

Before connecting a vent connector to the chimney, cement a sleeve first in place to facilitate removal of the vent connector for inspection and cleaning.

It is important that the vent connector does not protrude into the chimney since it might touch the opposite wall of the chimney, blocking off the vent and interrupting the venting process.



Chimney Use Restrictions

Solid-Fuel Appliance Restriction

Where a chimney flue in a dwelling unit serves a solid-fuelled appliance or active fireplace (where the opening from the fireplace to the flue is not permanently sealed), never use it to vent a gas burning appliance.

Reason for Restriction

This requirement is based on the risk of soot and creosote buildup in chimney flues serving solid-fuelled appliances, which may adversely affect venting and pose a potential fire hazard.

Alternative Options

In these cases, a separate venting system must be used for the gas appliance, or the solid-fuel appliance must be permanently decommissioned.

Factory-Built, Insulated Metal Chimneys

Purpose and Applications

Factory-built chimneys, or Type A vents, help vent oil or solid-fuel appliances, or gas appliances that have flue temperatures that exceed 470°F (243°C).

Because of the high temperatures, these vents are made of such heat-resistant materials as masonry (brick) or insulated steel. They often comprise two walls of stainless steel filled with insulating mineral fibre.

Construction and Assembly

An insulated metal chimney is not designed to be field cut. Lengths available range from 8 to 36 inches, depending on the diameters required by the venting system.

The fittings include tees with 15°, 30°, and 45° elbows. Note that 90° elbows are not available.

Accessories include wall, roof, and floor supports, adjustable offset supports, anchor plates, roof flashings, storm collars, and termination caps. Manufacturers use a twist-lock procedure to assemble an insulated metal chimney.

Chimney Liners

Purpose

Chimneys may require modification with a chimney liner that both reduces the inside diameter and restricts condensation.

Liners are usually ceramic or metal.

Ceramic Liners

The ceramic liner used in brick or masonry chimneys must be installed when the bricklayer is building the chimney.

Metal Liners

Manufacturers can make metal liners from rigid or flexible metals to suit specific venting applications.

These are often used to retrofit existing masonry chimneys for use with gas appliances.

Metal Chimney Liner Installation

Chimney Preparation

Thoroughly clean the chimney and check it for cracked, loose, or missing bricks, mortar, or other materials that could inhibit the correct installation of the lining system.

Liner Installation

Extend the liner to its maximum length before installation. Feed liner down from top of chimney, allowing approximately 12 inches to extend through basement wall and 6 to 12 inches to extend above the top of the chimney.

Top Termination

Center the liner at the top of the chimney using non-combustible material. Secure with cement mixture or flashing. Trim the liner to the required height and secure rain cap with three evenly spaced screws.

Bottom Connection

At the chimney inlet, place the mortar guard around liner and mortar it in place. Trim the liner at the chimney base, leaving a maximum of 2 inches extending beyond mortar guard and attach to the appliance.

Vent and Chimney Terminations

Wind Effects

Termination of vents or chimneys in areas where they would be susceptible to the effects of wind pressures can impair the effectiveness of vents.

Code Requirements

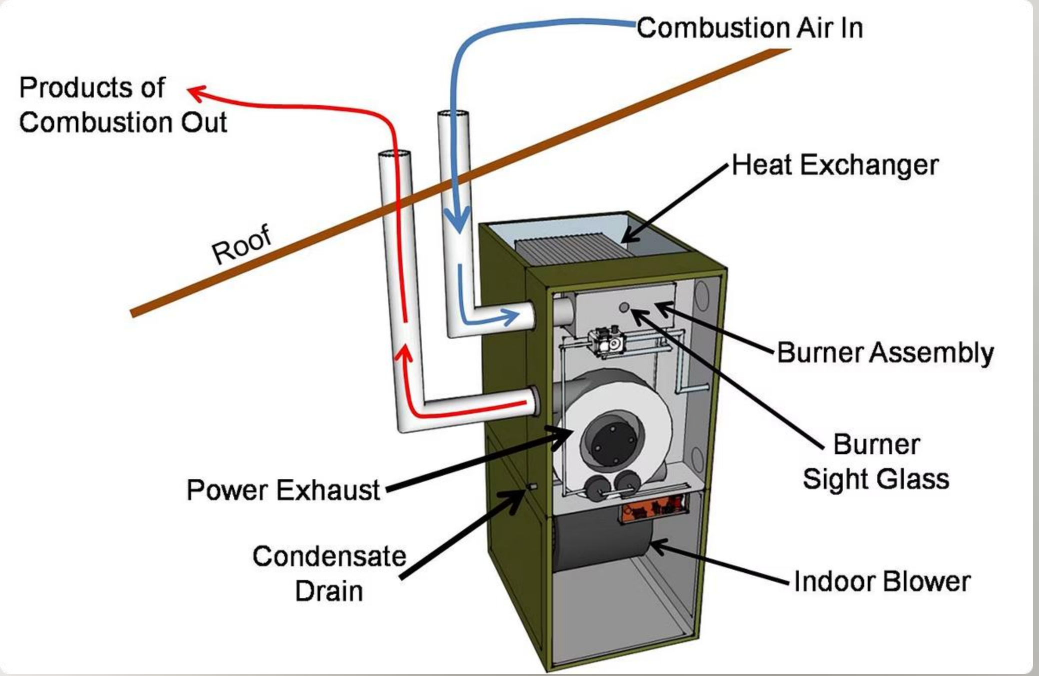
For this reason, CSA B149.1 prescribes the location of vent and chimney terminations and the minimum height and clearances for vent and chimney outlets.

Location Importance

Proper location ensures effective venting and prevents hazardous conditions from developing.

Clearance Requirements

Specific clearances from roof surfaces, walls, and other building features must be maintained.



CSA Unit 22

Chapter 3
Venting Design and Installation Requirements

CSA B149.1 covers venting design and installation requirements. It is important for the gas technician/fitter to know where to access specific information and be thoroughly familiar with Code clauses for general venting, as well as with NBC requirements and manufacturer's specifications.

Learning Objectives

Review Code Requirements

Review Code and other venting system requirements

Understand Venting Designs

Describe key aspects of venting designs for fan-assisted and draft-hood-equipped appliances

Identify Procedures

Identify procedural checklists for vent design and installation

Key Terminology

Term	Abbreviation (Symbol)	Definition
House Depressurization Limit	HDL	The maximum acceptable negative pressure condition within the building that will not affect the operation of appliances
Interpolation		An estimation of a value within two known values in a given sequence (e.g., estimating between table values
Extrapolation		An estimation of a value based on extending a known sequence of values beyond the area that is certainly known (e.g. extending table values)

Venting System Components

Support Components

Vent and chimney support

Multiple Appliance Venting

Vents and chimneys serving two or more appliances

External Venting

Vents outside buildings

Connection Components

Vent connectors, chimney connections, size and height of interconnected vent connectors

Multi-level Venting

Multi-storey venting

Venting Control Components

Flow Control

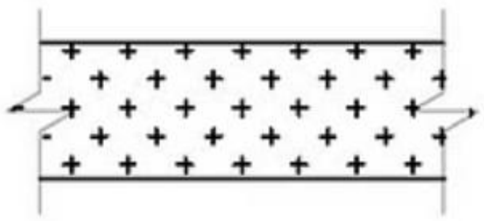
- Dampers and attachments
- Draft hoods
- Venting arrangements

Draft Regulation

- Draft regulators
- Automatic vent damper or automatic flue damper
- Manual operated flue dampers

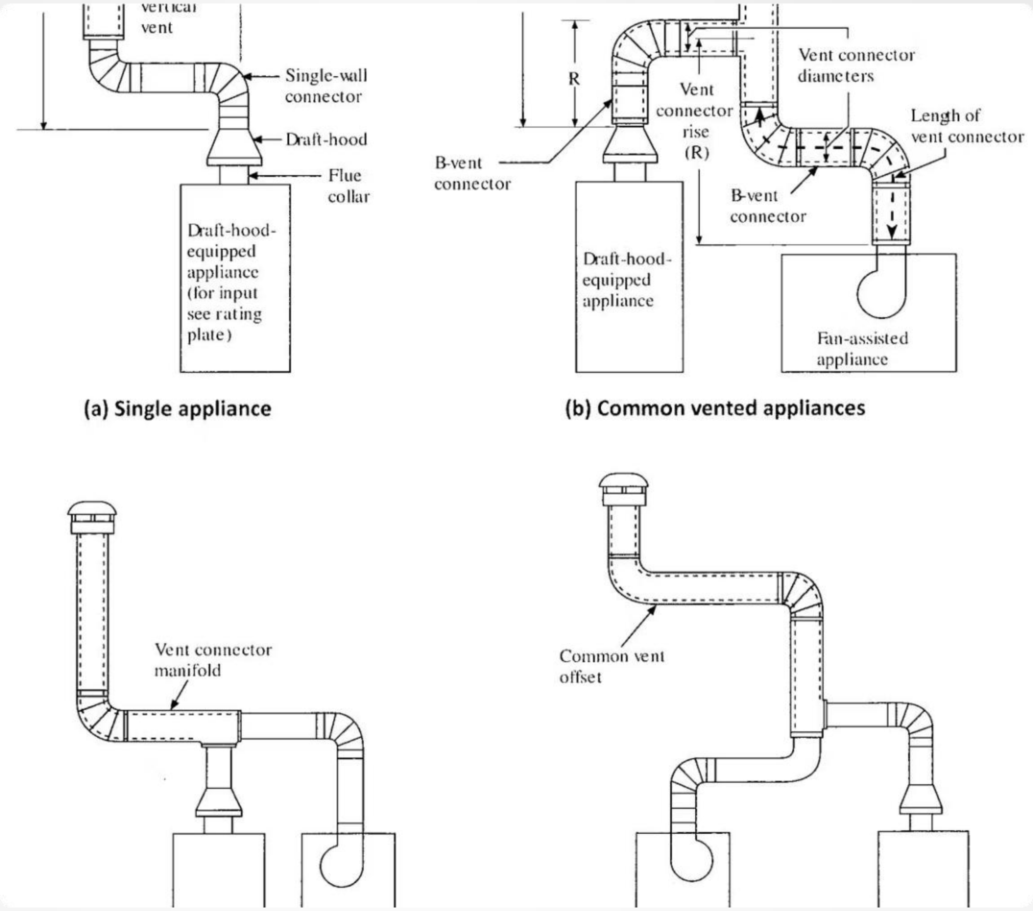
Special Applications

- Installation of draft control devices
- Induced or forced draft devices
- Venting of appliances into canopies
- Heat reclaimers

	insulation		
	Fire rated ductwork		Ductwork riser

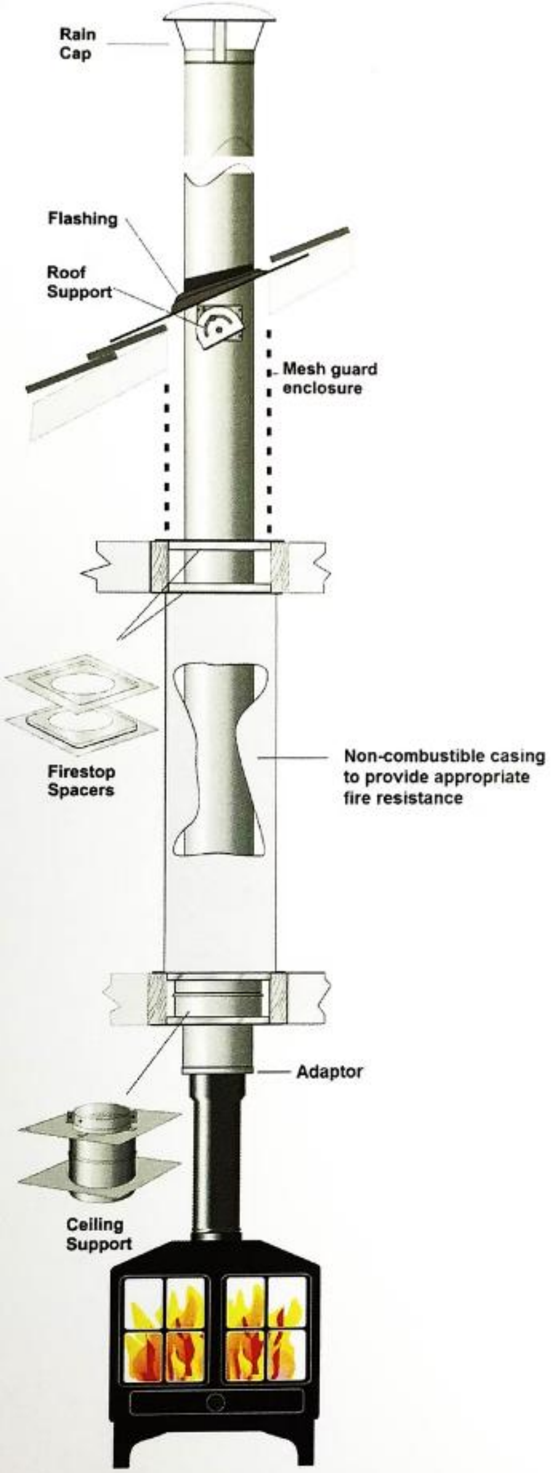
Venting Systems Terminology

Abbreviation	Terminology
DP (depressurization)	Maximum appliance input rating of a Category I appliance equipped with a draft-hood that could be attached to the vent when the appliance is located in a structure that complies with CSA B149.1, Clause 8.2.1 a) or b) (e.g., a tight structure that is equipped with avouct forme of other driver)
NAT+NAT	Maximum combined input rating of two or more draft-hood-equipped appliances attached to the common vent
NR (not recommended)	Means not recommended due to potential for condensate tormation and/or pressurization of the venting system
N/A	Means not applicable due to physical or geometric constraints

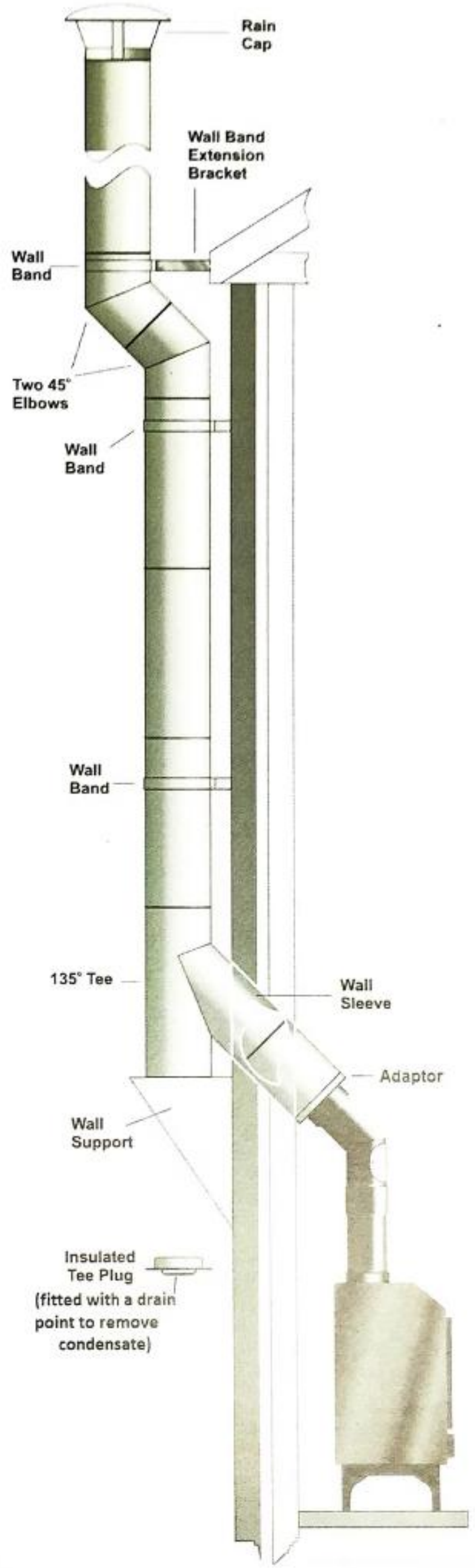


Venting System Components

Figure 3-1 shows different types of venting systems and the terminology applied to individual components. This diagram illustrates the various parts of a venting system including the chimney, vent, vent connector, and how they relate to different types of appliances.



Example of internal installation



Example of external installation

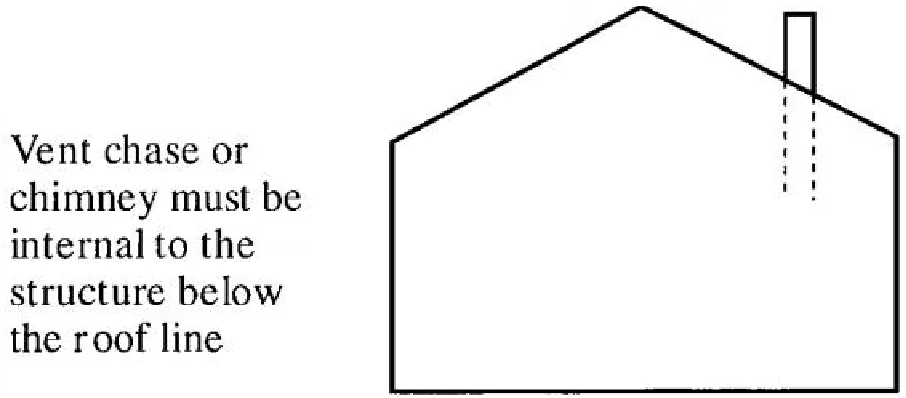
General Venting Requirements

The vent tables included in this Annex apply to vents and chimneys internal to the structure below the roof line. Exterior chimneys or vents not enclosed by the structure or a chase below the roof line can experience continuous condensation, depending on locality. A chimney with one or more sides exposed to the outside of the structure shall be considered to be an exterior chimney. A Type B vent or a certified chimney lining system passing through an unused masonry chimney flue shall not be considered to the outdoors. The DP column shall be used to determine the capacity of a venting system within a building constructed in accordance with Clause 8.2.1.

Internal Vent and Chimney Definition

Figure 3-2
Internal vent and chimney definition, external chimney definition

Figure 3-2 illustrates the definition of internal vents and chimneys according to the code requirements.



These diagrams show how venting systems are classified based on their location within or outside the building structure.

Vent Size Reduction Requirements

1 Vent Connector Size

Vents or vent connectors for appliance draft-hood outlets or flue collars 12 in (305 mm) or less in diameter are not reduced more than one table size [e.g., 4 in (102 mm) to 3 in (76 mm) is a one-size reduction]

2 Larger Vent Connectors

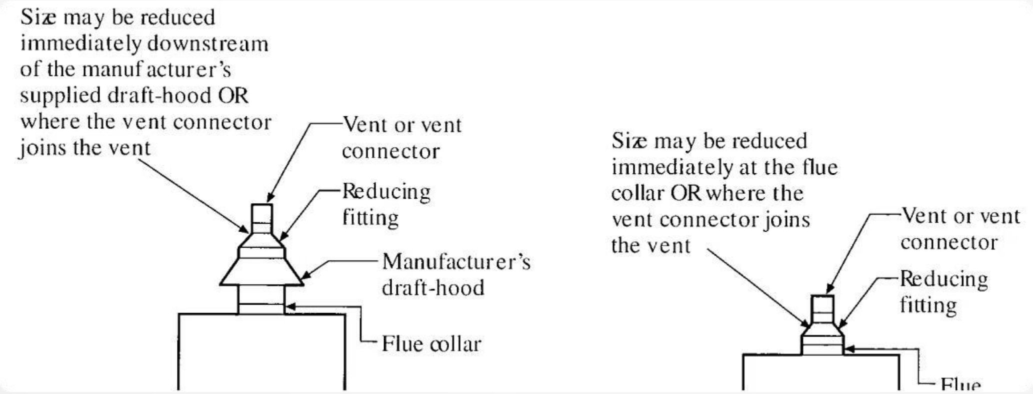
Vents or vent connectors for appliance draft-hood outlets or flue collars above 12 in (305 mm) in diameter are not reduced more than two table sizes [e.g., 24 in (610 mm) to 20 in (508 mm) is a two-size reduction]

3 Fan-Assisted Appliance Capacity

The maximum capacity listed in the tables for a fan-assisted appliance is reduced by 10% (calculated as 0.90 × maximum capacity)

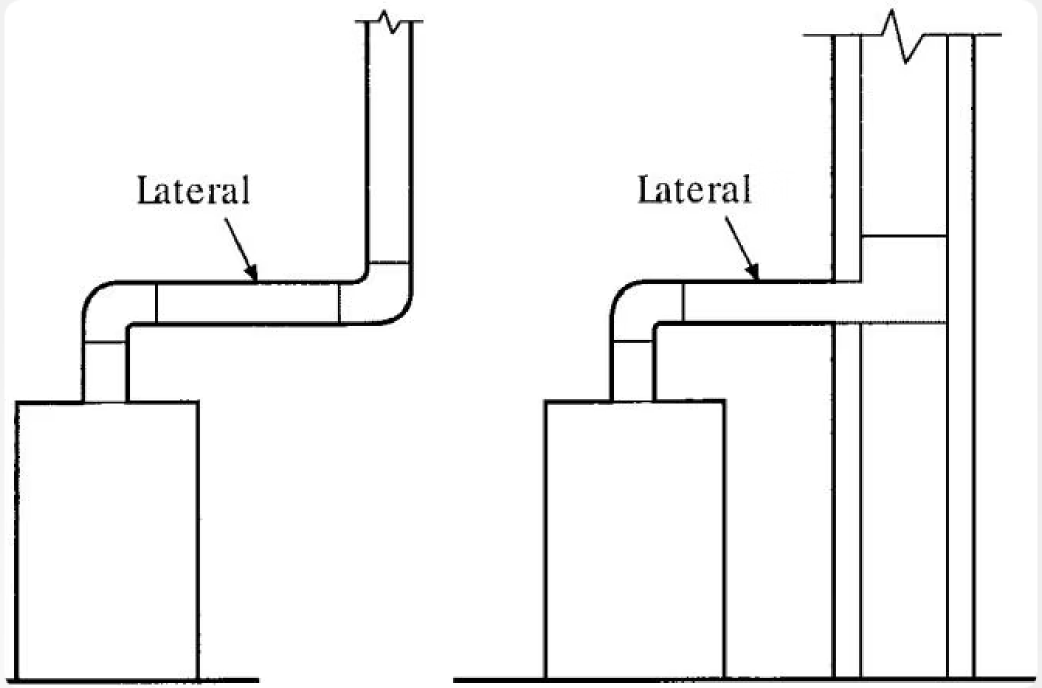
4 Draft-Hood Outlet Size

The draft-hood outlet is greater than 4 in (102 mm) in diameter. For example, a 3 in (76 mm) diameter vent or vent connector shall not be connected to a 4 in (102 mm) diameter draft-hood outlet. This provision shall not apply to fan-assisted appliances.



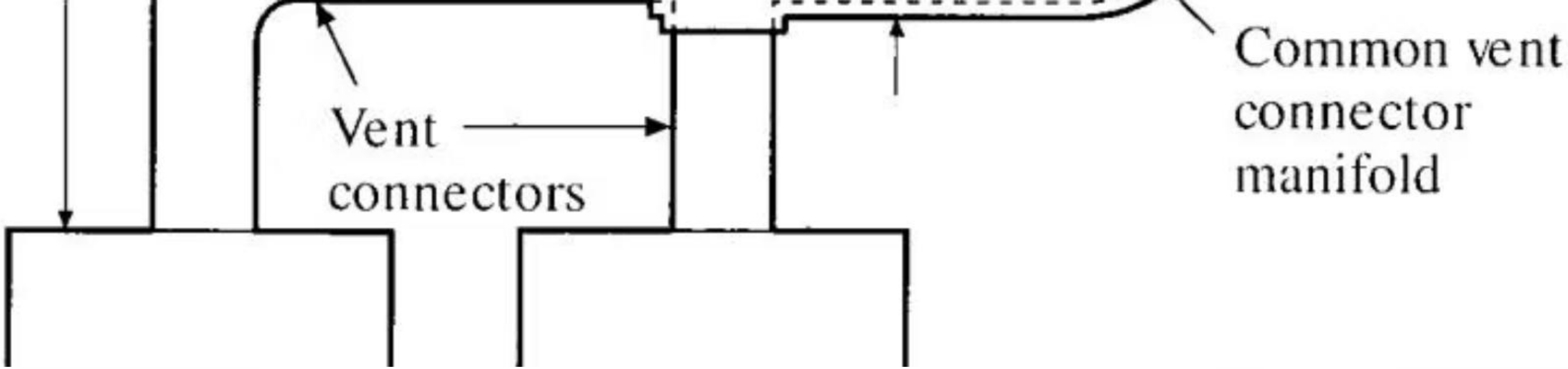
Use of Smaller Vents and Vent Connectors

Figure 3-3 illustrates the proper use of smaller vents and vent connectors. The diagram shows how vent sizes relate to draft hood outlets and the appropriate sizing requirements that must be followed for safe and effective venting.



Impact of Elbows on Vent Capacity

Figure 3-4 demonstrates how elbows reduce vent capacity. When lateral length is greater than zero, 2 elbows are assumed in Tables 1 and 2. The diagram illustrates how the configuration of elbows in a venting system affects the overall capacity and performance.

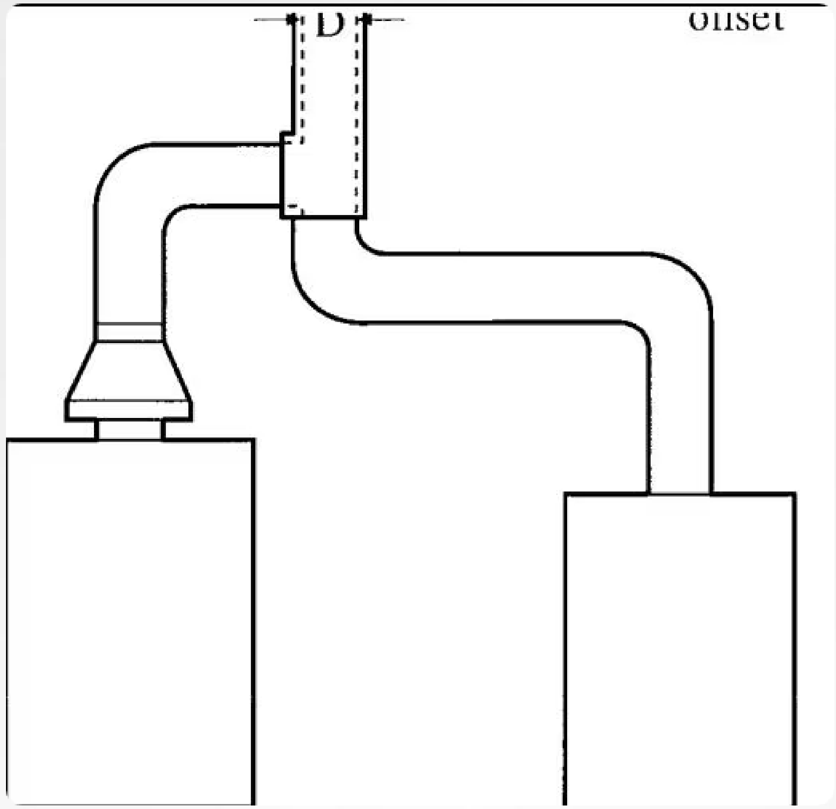


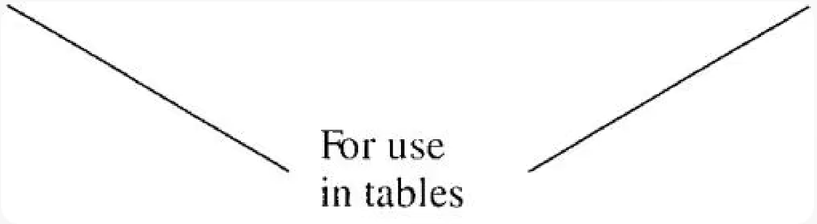
Combined Vent Connectors

> If vent connectors are combined prior to entering the vertical common vent, the maximum common vent capacity listed in the common venting tables shall be reduced by 10%, the equivalent of one 90° elbow (0.90 × maximum common vent capacity). The horizontal length of the common vent connector manifold (L in Figure C.9) should not exceed 1-1/2 ft (457 mm) for each inch (25.4 mm) of common vent connector manifold diameter.

Offset Common Vents

If the common vertical vent is offset as shown in Figure C.10, the maximum common vent capacity listed in the common venting tables should be reduced by 20%, the equivalent of two 90° elbows (0.80 × maximum common vent capacity). The horizontal length of the offset shall not exceed 1-1/2 ft (457 mm) for each inch (25.4 mm) of common vent diameter.





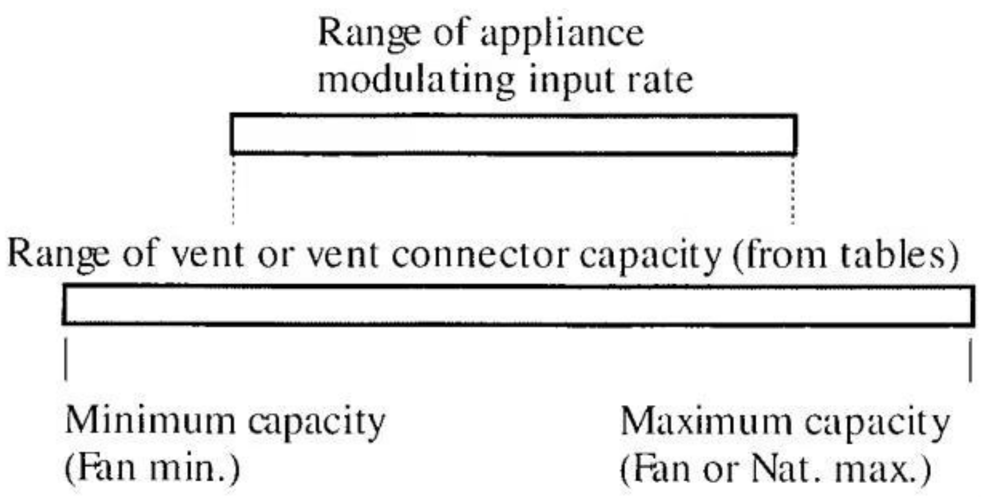
High-Altitude Installation Considerations

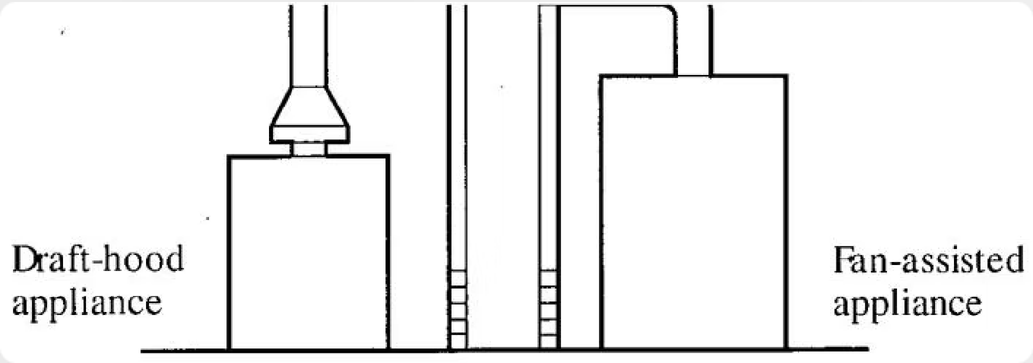
Use sea-level input rating when determining maximum capacity for high-altitude installation. Use actual derated input for determining minimum capacity for high-altitude installation. The actual high altitude input will have less heat, hence the reason for checking the minimum vent capacity. This lower heat input will take up the same amount of volume as the sea level rating. For this reason, it is necessary to also check the maximum capacity using the higher sea level rating.

Modulating Input Rate Appliances

For appliances with modulating input rates, the minimum vent or vent connector (FAN Min) capacity (determined from the tables) shall be less than the lowest appliance input rating, and the maximum vent or vent connector (FAN or NAT Max) capacity (determined from the tables) shall be greater than the highest appliance input rating.

Figure 3-8
Modulating input rates





Fan-Assisted Furnace Common Venting

> A fan-assisted furnace may be common-vented into an existing masonry chimney, provided that...

The image shows the requirements for common-venting a fan-assisted furnace into an existing masonry chimney, including specific conditions that must be met for safe operation.

Single-Appliance Venting Restrictions

> Single-appliance venting of a fan-assisted furnace into a tile-lined masonry chimney shall be prohibited. The chimney shall first be lined with either a Type B vent, sized in accordance with Table C.1 or C.2, or a certified lining system.

The intent of this general requirement is to prevent excessive condensation and poor venting performance when a single fan-assisted appliance is vented into a masonry chimney. To maintain a dry, warm vent, use a properly sized Type B vent or certified lining system.

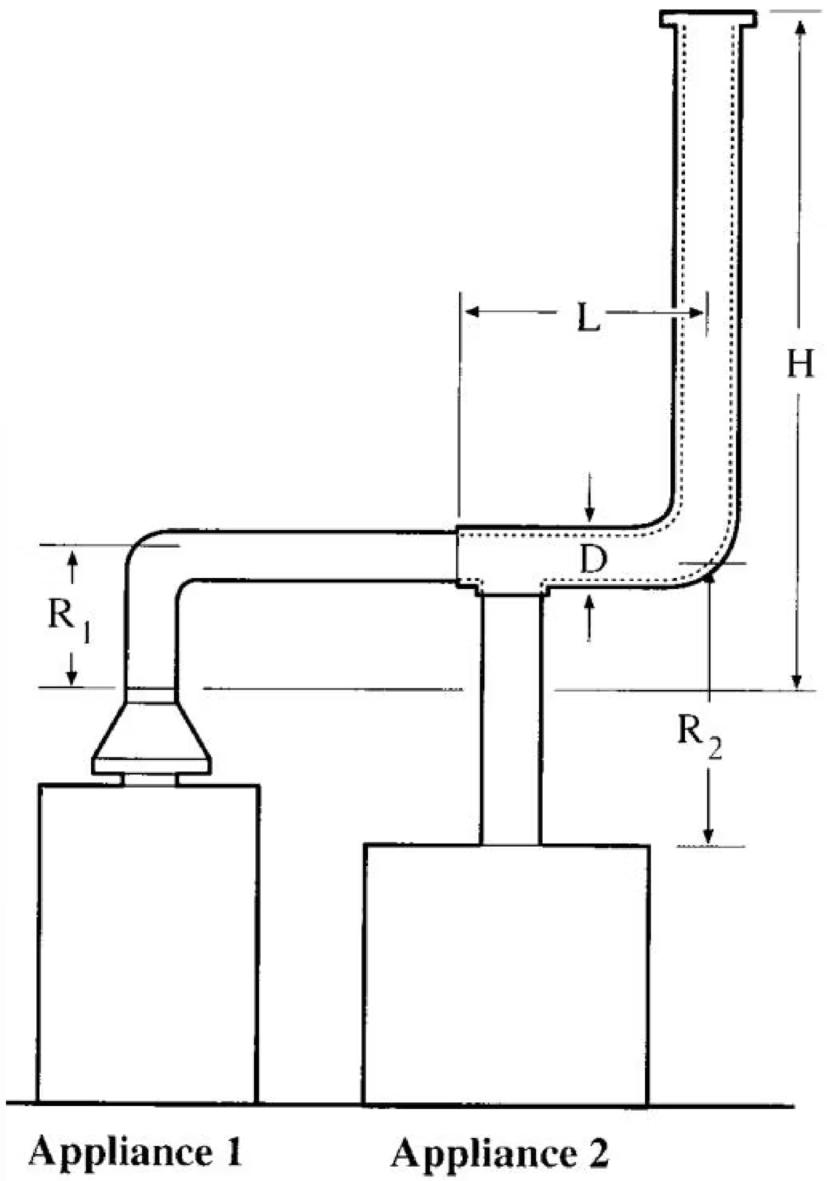
Corrugated Metallic Chimney Liner Systems

Certified, corrugated metallic chimney liner systems in masonry chimneys shall be sized according to Table C.1 or C.2 for dedicated venting and Table C.3 or C.4 for common venting, with the maximum capacity reduced by 20% (0.80 × maximum capacity) and the minimum capacity as shown in the applicable table. Corrugated metal vent systems installed with bends or offsets require additional reduction of the vent maximum capacity (see Clause C.2.6).

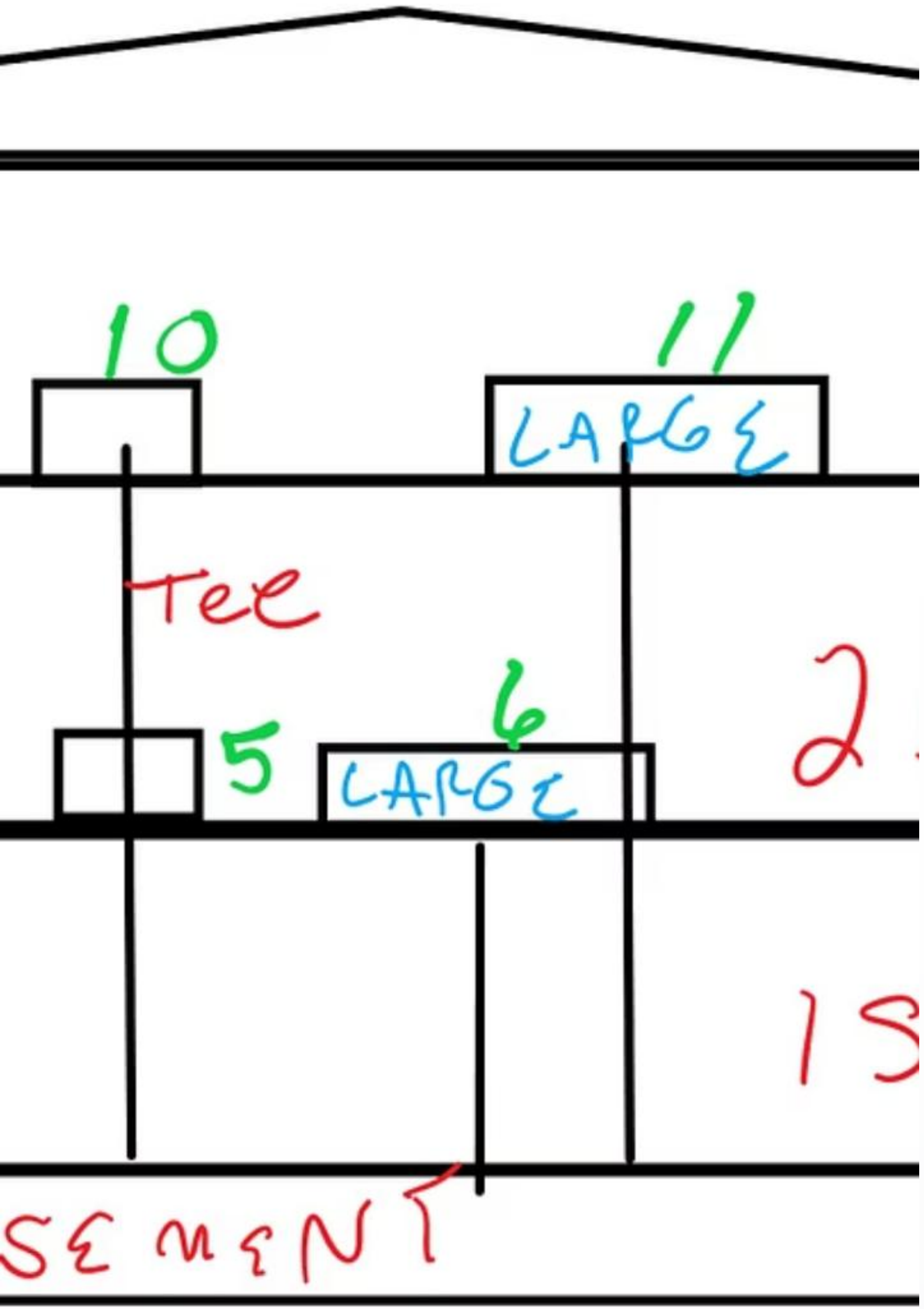
Chimney Liner System Sizing

Figure 3-10
Multi-unit installations

Size both vent connectors and chimney in accordance with Tables C.7 and C.8.



These diagrams illustrate the proper sizing requirements for chimney liner systems and how they should be installed in masonry chimneys.



Interpolation in Vent Sizing Tables

Interpolation is finding the capacity between table values graphically or mathematically. What if L is 7 ft?

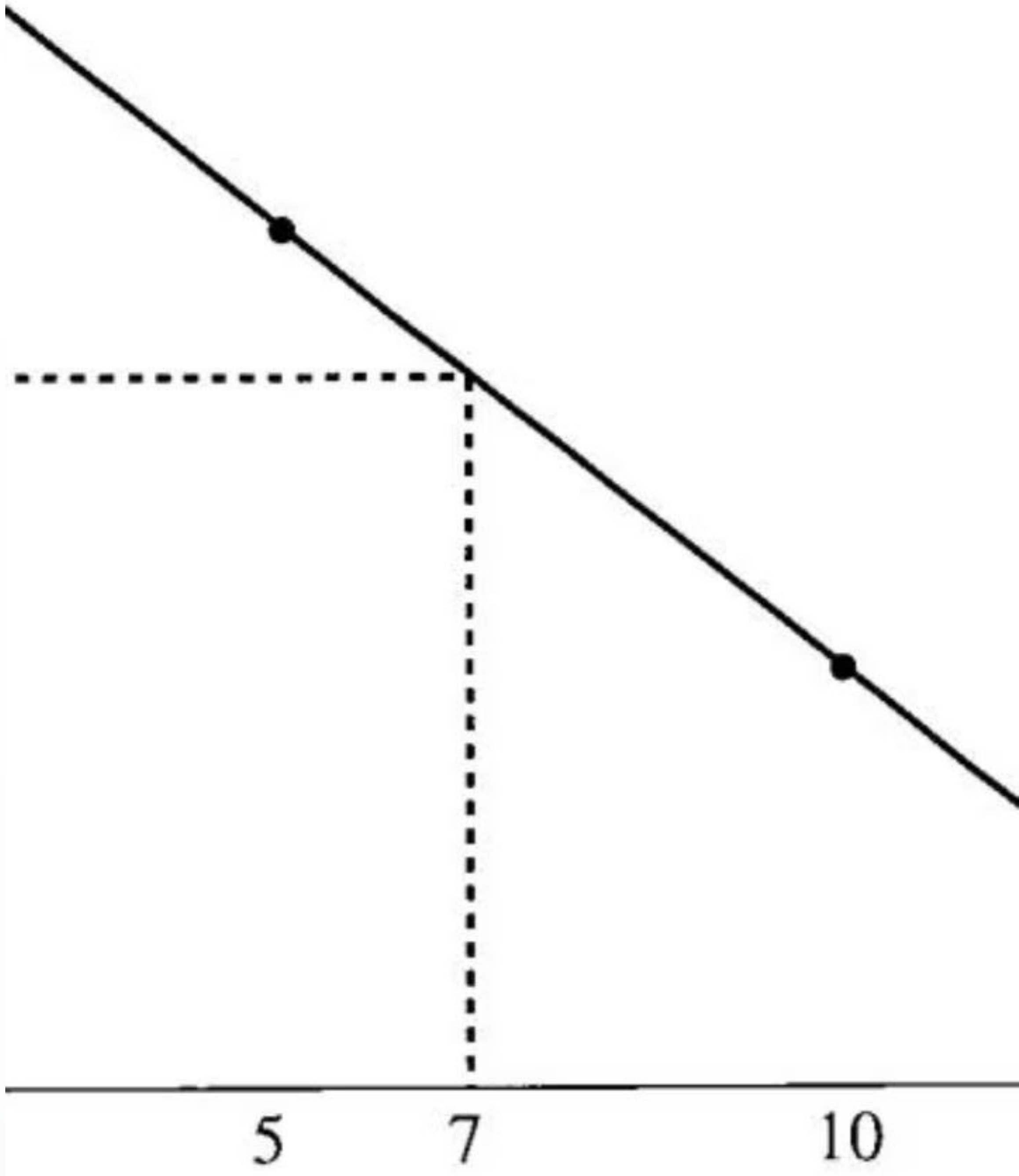
H(ft)	L(ft)	Btu/h x 1000
6	0	98
6	2	84
6	5	64
6	10	38

Graphical Interpolation Solution

The graphical solution shows how to visually determine values between table entries by plotting the known values and drawing a line to find the interpolated value.

$$64 - 2/5 \times (64 - 38) = 53.6 \text{ or } 53,600 \text{ Btu/h}$$

The mathematical solution provides a formula for calculating the interpolated value directly from the table values.



Venting System Design Checklist

Vent Size Verification

Is the vent or vent connector size from the tables smaller than the draft hood outlet or flue collar? See GVR C.2.3

Elbow Configuration

Are there more than two 90° elbows or their equivalent? See GVR C.2.4

Connector Manifold

Is there a common vent connector manifold? See GVR C.2.5

Vent Offset

Is there a common vent offset? See GVR C.2.6

Additional Venting System Considerations

Altitude Factors

Is it a high altitude installation? See GVR C.2.7

Modulating Appliances

Does the installation involve an appliance with a modulating input rating? See GVR C.2.8

Masonry Chimney Use

Is there common venting of a fan-assisted furnace through an existing masonry chimney? See GVR C.2.9

Single Appliance Venting

Is a single fan-assisted appliance venting through a tile-lined, masonry chimney? See GVR C.2.10

Final Venting System Verification

Chimney Liner

Is a certified, corrugated metallic chimney liner to be used? See GVR C.2.11

Multi-Unit Installation

Is this a multi-unit installation? See GVR C.2.12

Multi-Storey Installation

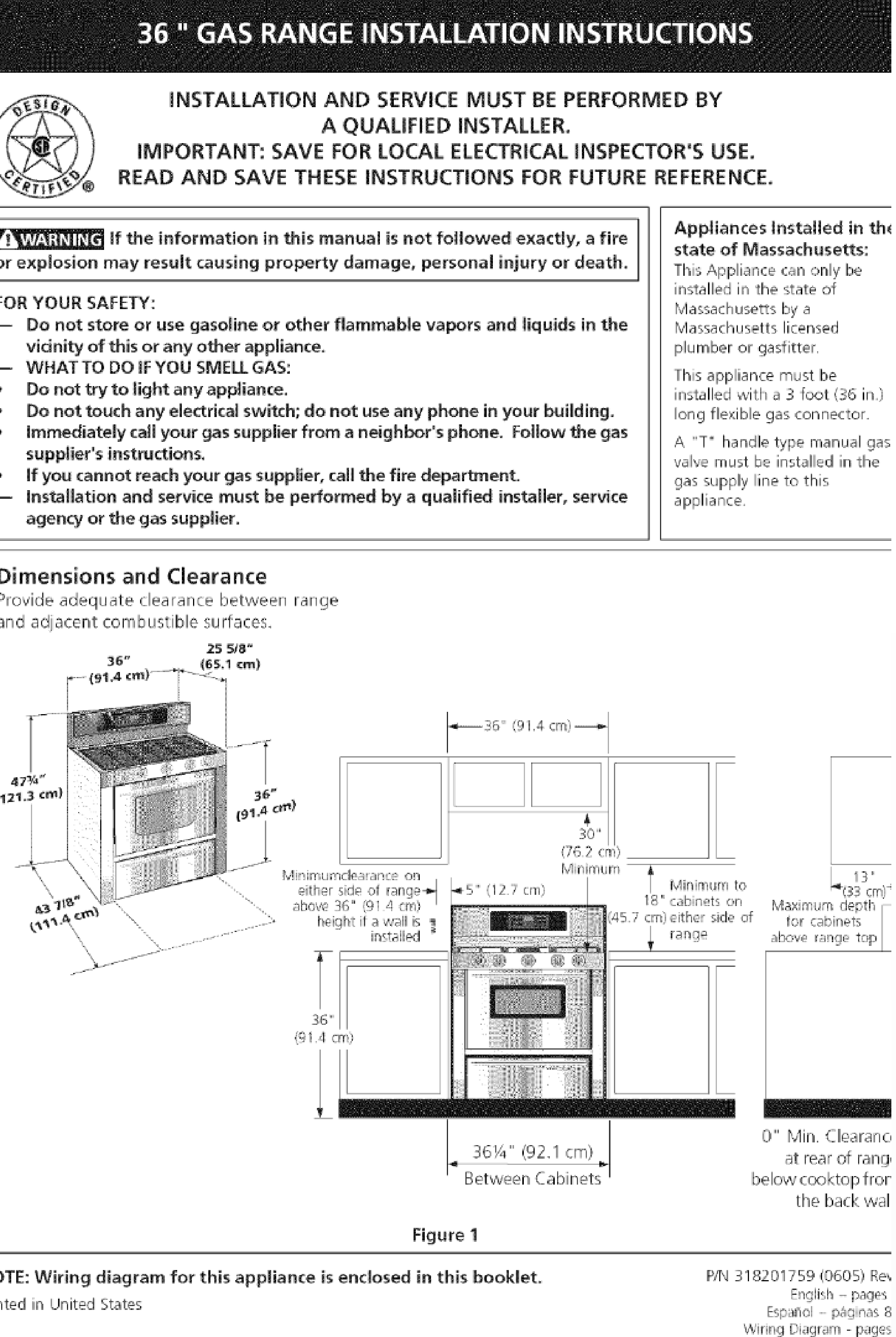
Is this a multi-storey installation? See GVR C.2.13 and C.2.14

Dimensional Verification

Is the vent height, connector rise, and lateral not shown exactly on the tables? See GVR C.2.15

Multiple Diameter Options

Are two or more diameters permitted for vents or vent connectors from the tables? See GVR C.2.16


36 " GAS RANGE INSTALLATION INSTRUCTIONS

INSTALLATION AND SERVICE MUST BE PERFORMED BY
A QUALIFIED INSTALLER.
IMPORTANT: SAVE FOR LOCAL ELECTRICAL INSPECTOR'S USE.
READ AND SAVE THESE INSTRUCTIONS FOR FUTURE REFERENCE.

WARNING If the information in this manual is not followed exactly, a fire or explosion may result causing property damage, personal injury or death.

FOR YOUR SAFETY:
- Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.
- WHAT TO DO IF YOU SMELL GAS:
- Do not try to light any appliance.
- Do not touch any electrical switch; do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.
- Installation and service must be performed by a qualified installer, service agency or the gas supplier.

Appliances Installed in the state of Massachusetts:
This Appliance can only be installed in the state of Massachusetts by a Massachusetts licensed plumber or gasfitter.

This appliance must be installed with a 3 foot (36 in.) long flexible gas connector.

A "T" handle type manual gas valve must be installed in the gas supply line to this appliance.

Dimensions and Clearance
Provide adequate clearance between range and adjacent combustible surfaces.

Figure 1

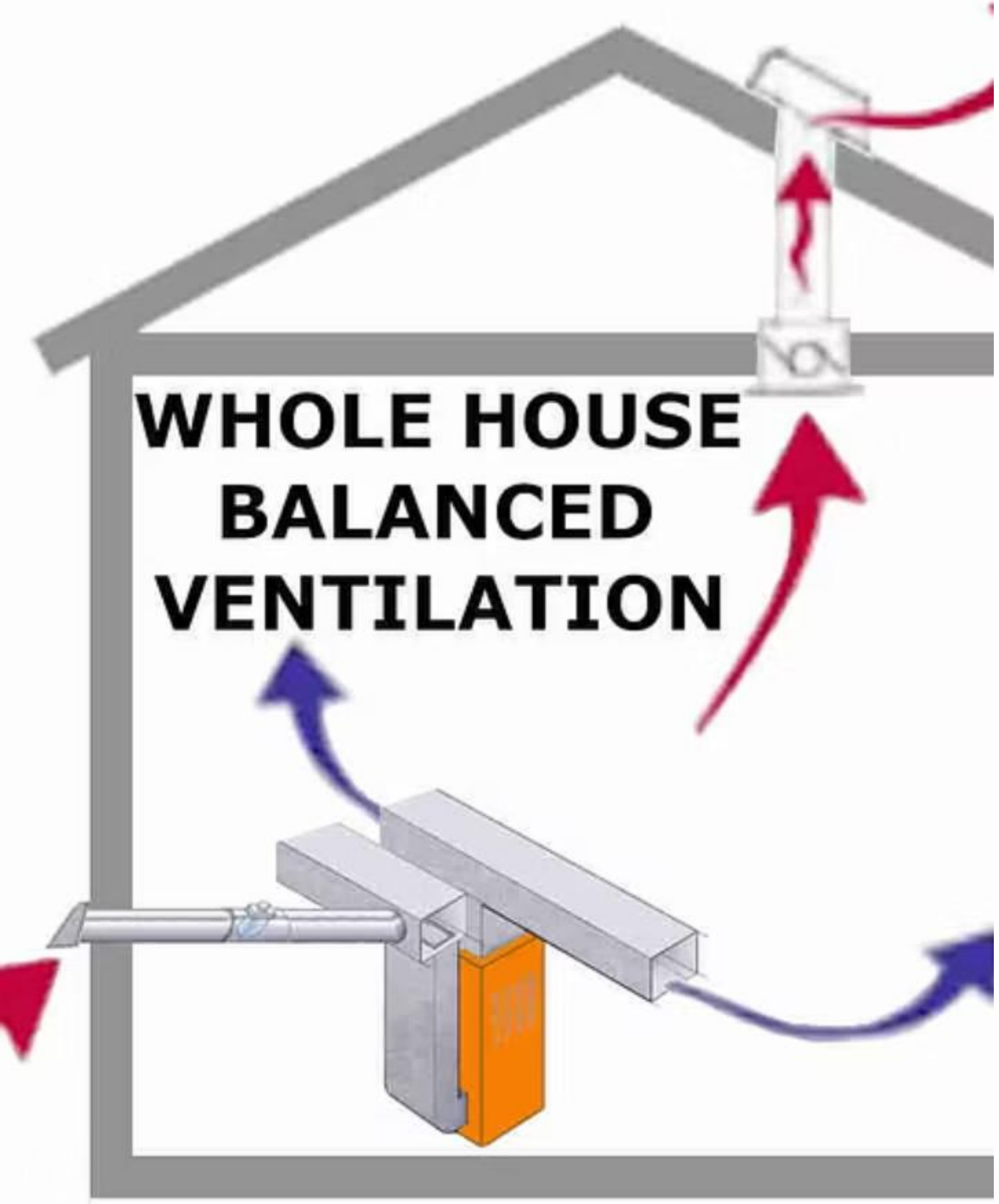
NOTE: Wiring diagram for this appliance is enclosed in this booklet.
Printed in United States

P/N 318201759 (0605) Rev
English – pages
Español – páginas 8
Wiring Diagram - pages

Manufacturer's Literature Importance

> Installers of venting systems should carefully adhere to the manufacturers' certified instructions for the appliance and venting system, as well as Code requirements and design plans.

Following manufacturer's instructions is critical for proper installation and safe operation of venting systems. These instructions are specifically designed for each appliance and provide important details that may not be covered in general code requirements.



House-as-a-System Approach

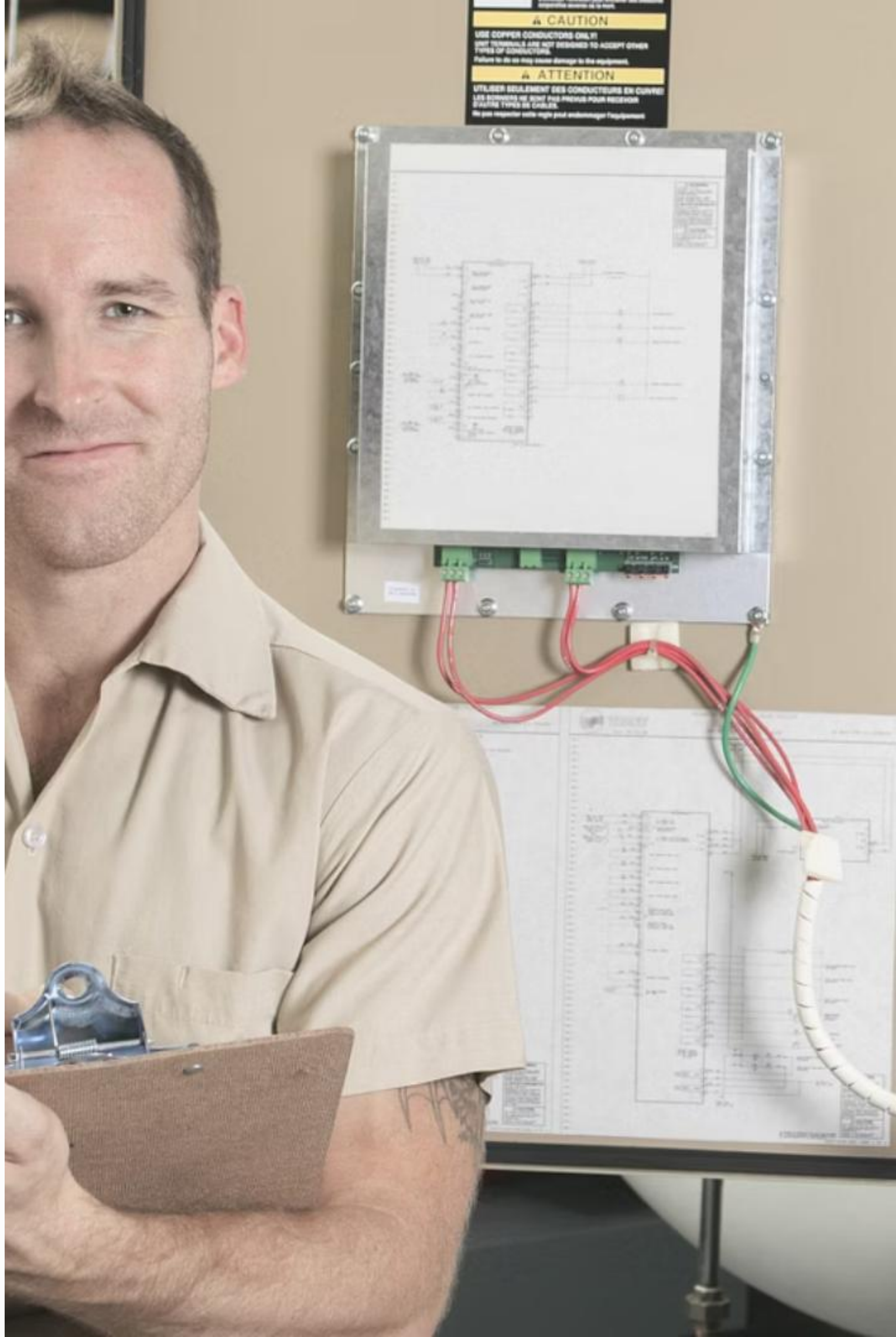
Building Codes require that the system of air supply to people and equipment that traditionally occurred through leaks in the building envelope is now provided mechanically.

By taking a house-as-a-system approach, researchers were able to recognize that eliminating one form of air supply (air leakage) called for compensation with another form of air supply (mechanical ventilation). Failing to account for such factors can severely disrupt the house-as-a-system balance.

House Depressurization Concerns

Although there are many other examples of such interaction, the main focus for the gas appliance installer is on maintaining a balance between air pressures and air flows. With the increased number of "tight" new and renovated houses and major air exhausting appliances (clothes dryers, central vacuums, and range hoods), the chance of exceeding the House Depressurization Limit (HDL) of 5 Pa is greatly increased. This means that you must check the house pressures so as to accurately gauge the state of the house as a system.

Installers must be certain whether installation of a fan-assisted or natural-draft appliance in a house can be safe.



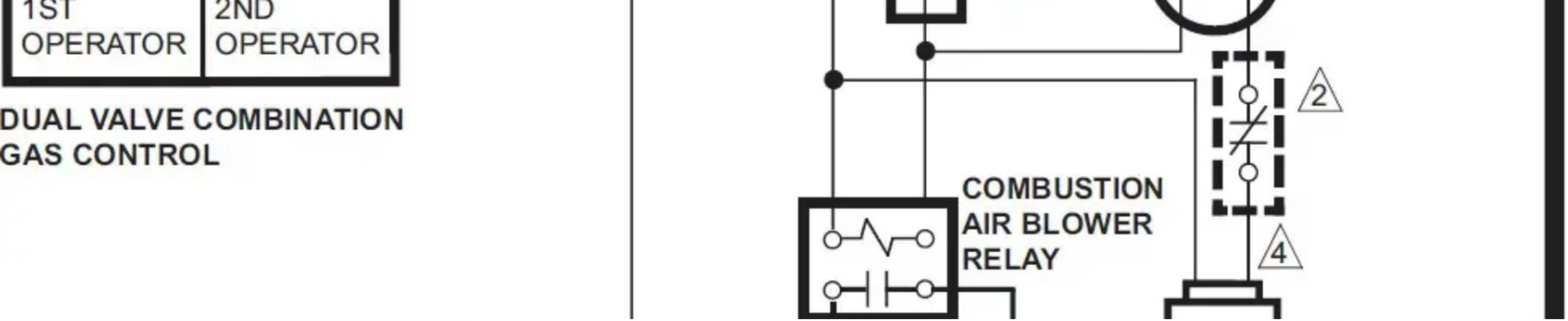
Vent Sizing Table Prerequisites

Building Depressurization

The building in which you are to install the appliances must not develop depressurization greater than 0.02 inch w.c. (5 Pa). This is known as the House Depressurization Limit (HDL). If house pressures cannot be reliably controlled within the HDL, you should never install fan-assisted and draft hood appliances. Vent sizing tables would thus not apply.

Venting System Layout

The layout of the venting system must fall within the limits of the vent sizing tables in terms of vent height, length of laterals, vent connector rise, and vent sizes. If any aspect of the venting system exceeds these limitations the venting tables should not be used, as the system must be engineered according to approved practices.

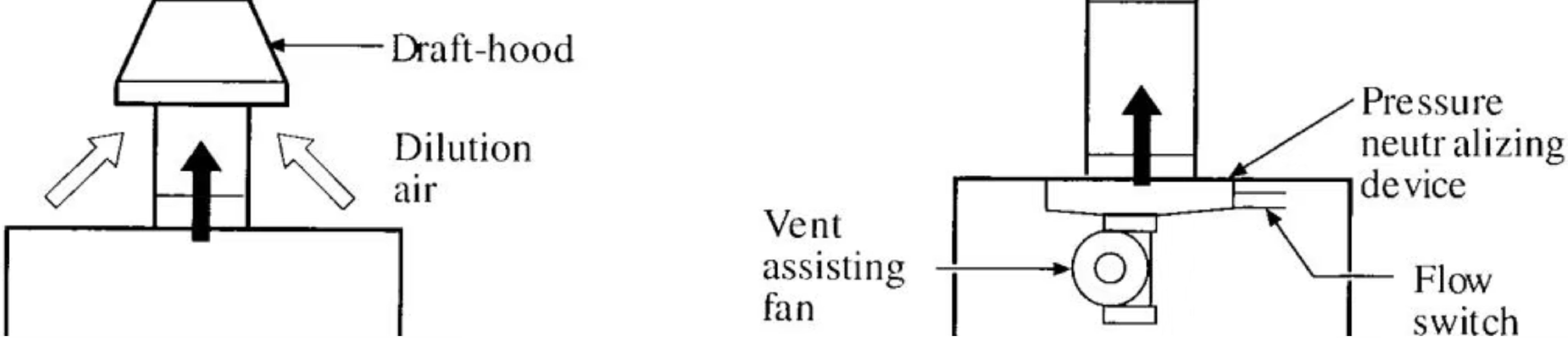


Fan-Assisted Combustion System

A fan more precisely regulates combustion air supply. Unlike forced or induced draft equipment, the fan does not develop any venting pressure, but delivers air at a rate that results in complete combustion without as much excess air as a natural draft appliance.

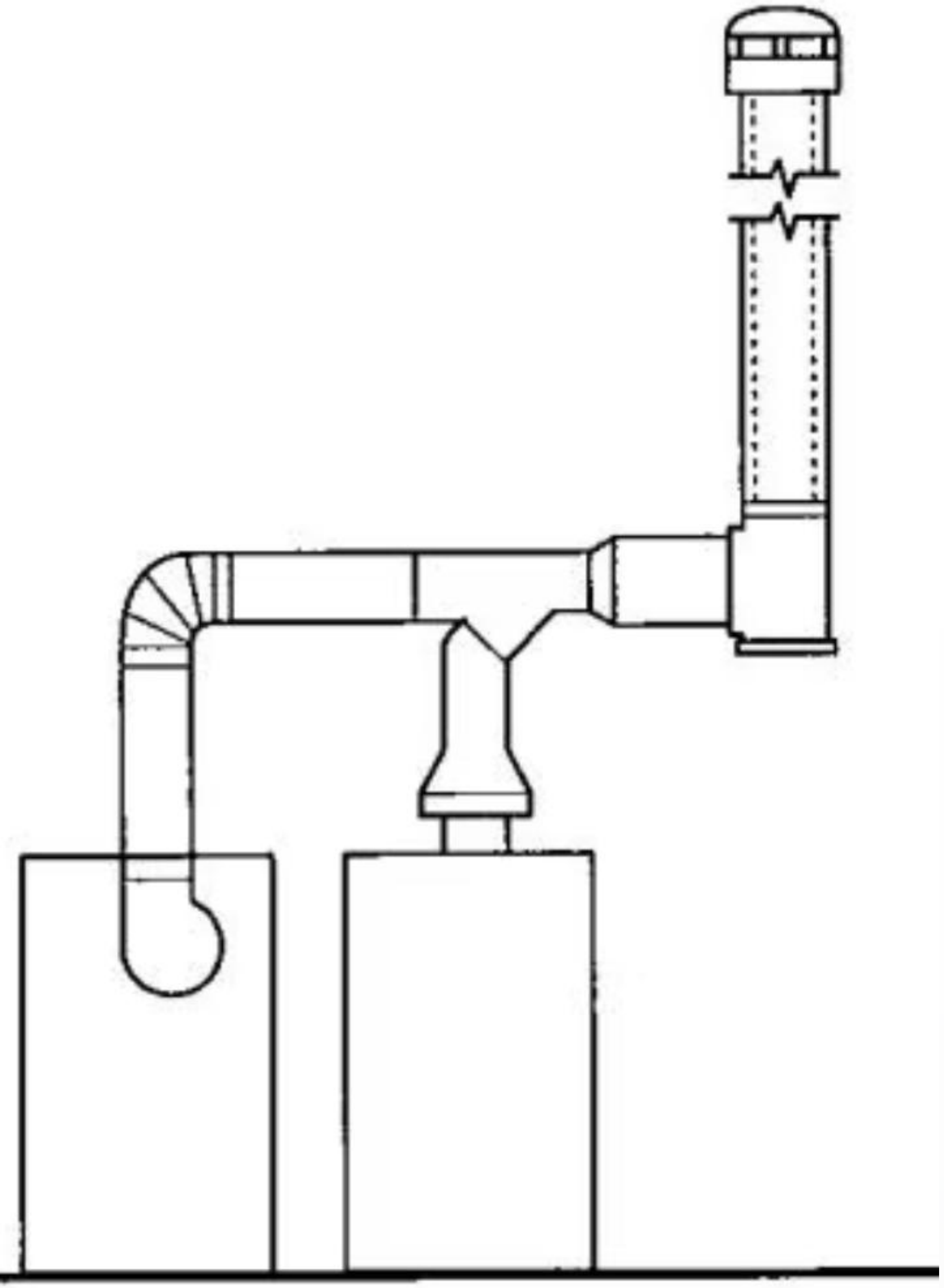
Venting is still dependent on buoyancy, and a type of draft pressure neutralization device is generally used upstream of the burner. From this point on, buoyancy forces vent flue gases.

A flow switch is incorporated, proving that the burner fan is operating.



Venting and Draft Characteristics

Figure 3-12 shows typical venting and draft characteristics for both natural draft and fan-assisted gas appliances. The diagram illustrates the different pressure profiles and flow patterns that occur in these two types of venting systems.



Common Venting System Configurations

In Figure 3-13(a), flue gases from the fan-assisted appliance can settle in the common vent, holding back flue gases from the fan-assisted appliance. In some cases, the path of least resistance for the flue gases leads through the draft hood of the water heater, causing spillage into the building.

Figures 3-13(b) and 3-13(c) are generally recognized as "better practice" alternatives to the system shown in Figure 3-13(a).

Improved Common Venting Configurations

Y

Y-Fitting Configuration

In Figure 3-13(b), a "Y" fitting for the water heater downstream of the fan-assisted appliance improves the venting of the water heater and may reduce the potential for spillage.

Elevated Connection

In Figure 3-13(c), the connection of the water heater is above the connection of the fan-assisted appliance. When the fan-assisted appliance is operating alone, its flue gases warm the air in the common vent below the water connection. As venting is established, the flue gases rise vertically by passing the water connection. In properly designed and installed venting systems, this configuration was found to be most effective in minimizing spillage.

Appliance Venting Design Considerations

1 Installation Type

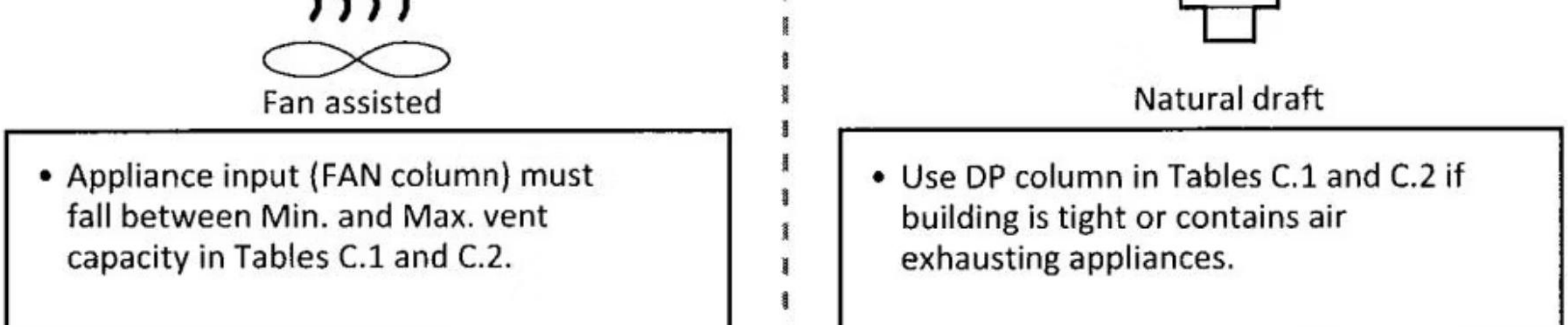
Note that different considerations apply to a new appliance group installation versus replacement of one or more existing appliances.

2 Appliance Type

Consider different requirements and parts of the tables apply to fan-assisted versus natural draft appliances.

3 Layout Complexity

Make adjustments to capacities listed in the tables to account for additional fittings beyond those originally used in developing the current version of the vent sizing tables, depending on the simplicity or complexity of the layout.

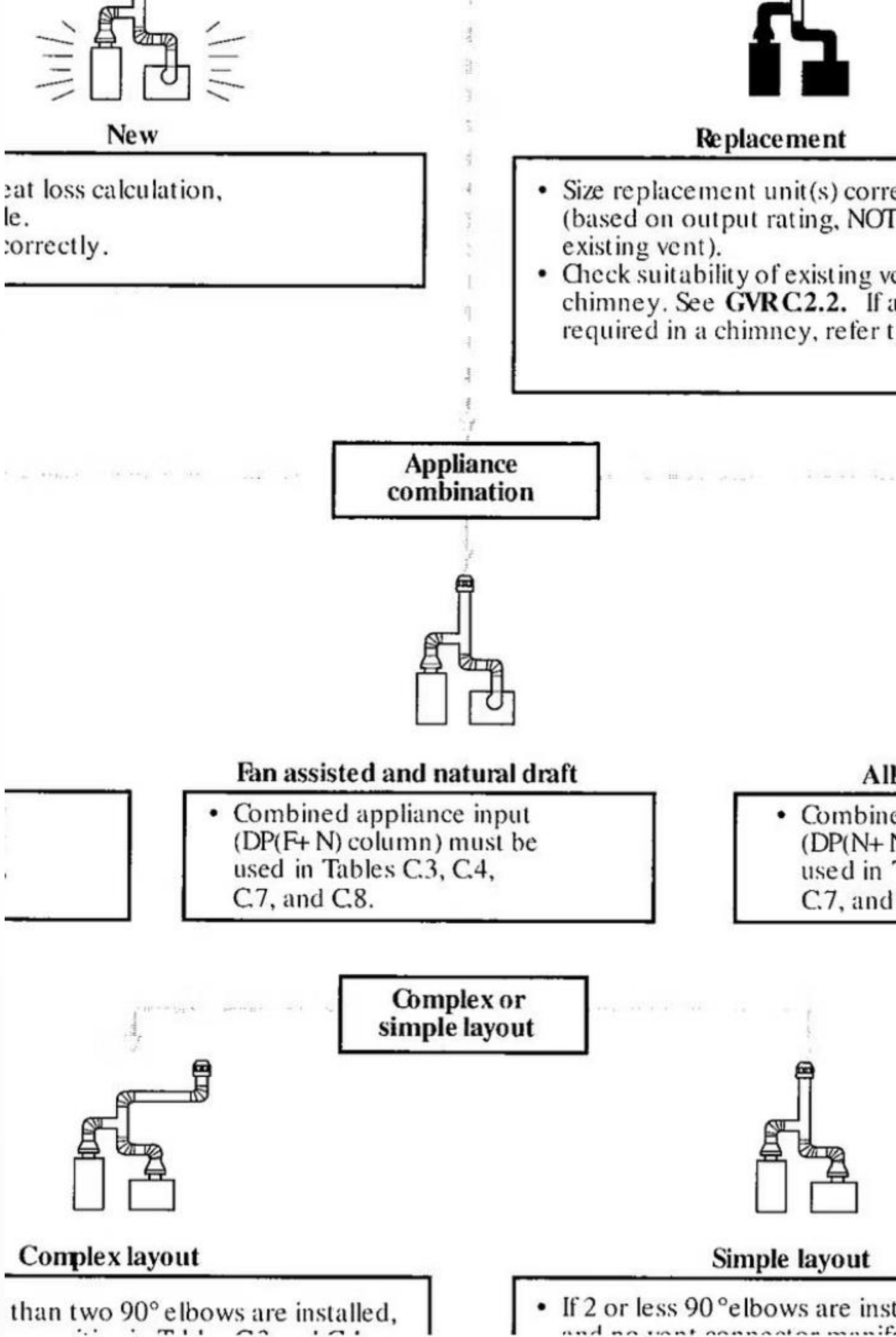


Common Venting Chart

This chart provides guidance for common venting of two or more appliances. It helps determine the appropriate sizing and configuration based on the types of appliances being vented together.

Multi-Storey Venting Systems

Multi-storey venting systems require special consideration for both new installations and replacement of appliances in existing systems. The diagram shows how these systems are configured across multiple floors of a building.



New Multi-Storey Venting Systems

Professional Design

Obtain the design from a design professional or the venting system manufacturer.

Pre-Installation Review

Review the design with the local inspection authority and/or utility before installation to avoid costly surprises.

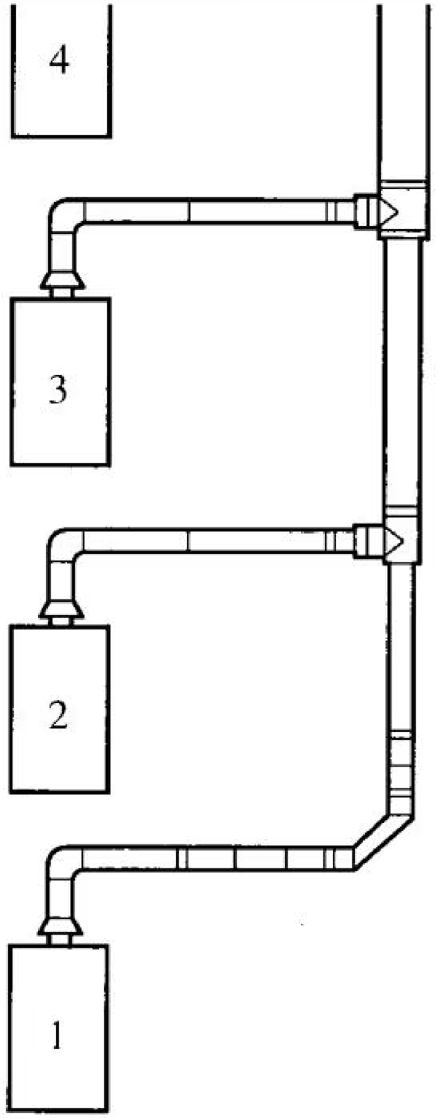
Proper Installation

Install the system according to the design drawing and specifications. Seek prior approval for substitution of certified components. Where the system has been engineered, the designer must review the installation before it is closed in.

Inspection Coordination

Arrange and coordinate inspections according to the work plan and avoid delays.

Replacing Appliances in Multi-Storey Systems



It is more common to have to replace appliances connected to a multi-storey venting system (Figure 3-16). The gas technician/fitter should note the following key points:

Compatible Replacement

The replacement appliance(s) should be of the same size (output capacity) and venting type (fan-assisted versus natural draft) as the original appliance(s). The replacements should be compatible with the multi-storey venting system.

Avoid Significant Changes

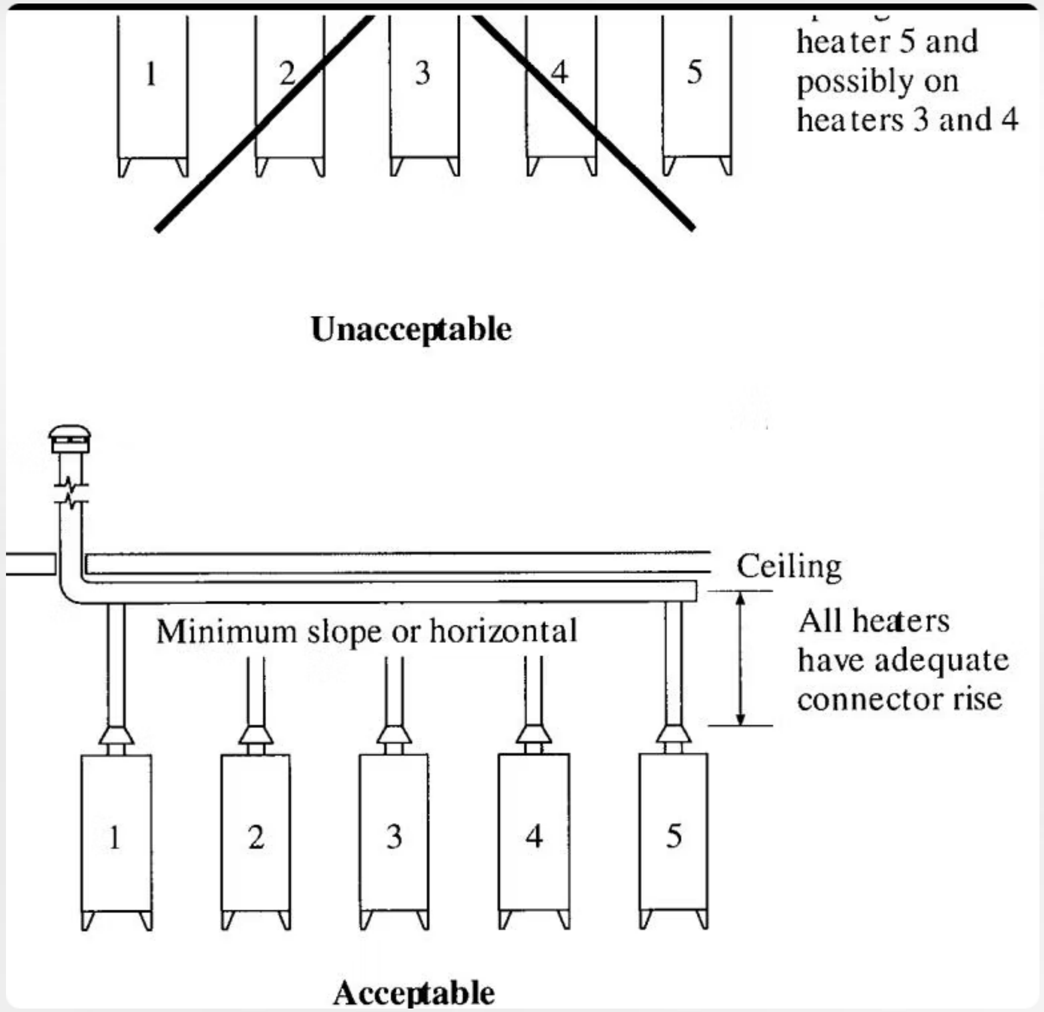
Do not make significant changes to the venting system or add additional appliance inputs without first seeking competent advice.

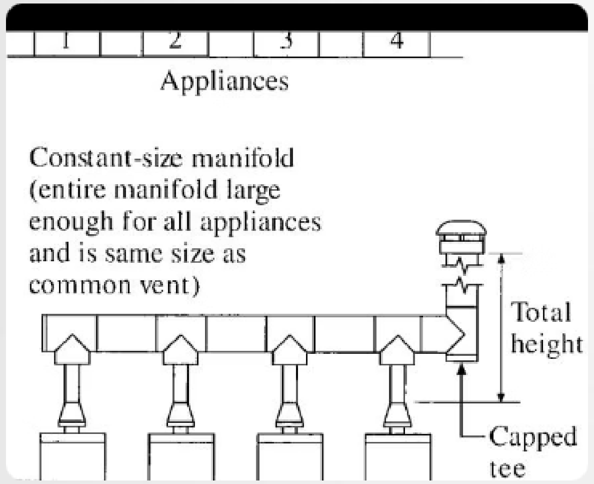
Performance Issues

If venting system performance problems are observed or reported, do not proceed with any alteration to the system or connect appliances without contacting the local inspection authority or utility.

Sloped vs. Horizontal Manifolds

Exceeding the minimum slope requirements for a manifold can cause trouble. An example is draft hood spillage from the appliance most distant from the vertical vent. The lack of adequate connector rise for this situation is shown in Figure 3-17. It is preferable by far to use a horizontal manifold than to slope it excessively.





Tapered vs. Constant-Size Manifolds

You can taper manifolds for the actual input to the particular section, or they can be of constant diameter using the selected common vent size. There is no significant difference in the operating characteristics of these two options (Figure 3-18).

Manifold Design Types

Type	Description
Tapered	· For each section of the tapered manifold, increase the total combined rated heat input by 11% (which is the same as reducing table capacity to 90%). · You can find the total height for that section based on the highest connected appliance outlet. As you pick up succeeding appliances, add each input multiplied by 1.11 to find the next size.
Constant-size	· Add together the rated inputs of all connected appliances, and multiply the sum by 1.11. This final number is the design input for a manifold of constant size. · Total height is the basis of the highest connected appliance outlet.

Pre-Installation Checklist

Local Approval

Is this type of installation approved by the local inspection authority or utility?

Appliance Certification

Is the appliance (or appliances) certified and appropriately sized? Check the output rating for replacement appliances.

Component Certification

Are all of the components of the system to be installed certified?

Venting System Design

Has the venting system design been checked for proper application of the vent sizing tables and requirements that apply?

HVAC Preventative Maintenance Checklist

tion	
ling	
pleted By	

Monthly Tasks	Done
k and replace air filters if dirty	
:ct the thermostat for accuracy and proper operation	
:ct the indoor unit for any visible signs of damage or leaks	
· any obstructions blocking the airflow around the indoor unit	

Seasonal Tasks	Done
ıg	
ı the outdoor condenser unit, removing debris and vegetation	
:ct the condensate drain line and clear any clogs	
k electrical connections and tighten if necessary	
cate moving parts as recommended by the manufacturer	
:he system's performance and measure refrigerant levels	
mer	
tor the system's performance and listen for any unusual sounds	
k refrigerant levels and adjust if needed	
:ct and clean the outdoor condenser coils	
/ the accuracy of the thermostat settings	
:ct and clean the combustion chamber (for gas furnaces)	
k and clean the burner assembly and ignition system (for gas furnaces)	
ıine the heat exchanger for cracks or corrosion (for gas furnaces)	
:he ignition system and safety controls (for gas furnaces)	
:ct and clean the blower assembly	
er	
:ct the heat exchanger for any signs of damage (for gas furnaces)	
k the flue system for proper ventilation (for gas furnaces)	
cate the blower motor if necessary	
:ct and clean the air ducts, removing any dust or debris	
tor the system for efficient heating	

Additional Pre-Installation Checks

Detailed Layout

Does the installer have a detailed sketch of the layout showing dimensions and sizes, which includes a list of materials?

Special Tools

Are any special tools or equipment required for the particular appliance and venting system?

Chimney Inspection

Has the existing chimney been inspected to ensure it is clean, unobstructed, and lined properly?

Installer Qualifications

Are the installers experienced and qualified for this work?

During Installation Checklist

Appliance installation calls for good workmanship, particularly in the installation of the venting system.

Installation Feasibility

Can the appliance be installed according to the venting system design? If modifications are necessary, make a check using vent sizing tables or manufacturer's installation instructions, and revise components as required.

Component Verification

Have all of the required components of the venting been installed? Check manufacturer's certified installation instructions.

Joint Inspection

Are all of the joints in vents properly connected, with no projections into the vent? Internal obstructions can upset proper vent performance.

Venting System Inspection Points

Check All Connections

Verify that all joints are properly sealed and secured according to manufacturer's specifications

Inspect for Obstructions

Ensure there are no internal projections or debris that could restrict proper flow

Verify Proper Slope

Confirm that horizontal sections have the correct upward slope toward the vertical vent

Test System Operation

Perform operational tests to verify proper draft and no spillage under normal conditions

Venting System Safety Considerations

Combustion Air Supply

Ensure adequate combustion air is available for all appliances in accordance with code requirements

Depressurization Testing

Verify that house depressurization does not exceed the 5 Pa limit when all exhaust devices are operating

Carbon Monoxide Safety

Install carbon monoxide detectors in accordance with local regulations to provide early warning of venting problems

Common Venting System Issues

External Factors

Wind conditions, temperature differences, and building pressurization can affect venting performance

Improper Sizing

Undersized or oversized vents can lead to poor draft, condensation, or spillage

Poor Connections

Loose joints, improper sealing, or incorrect assembly can compromise system integrity

Blockages

Debris, animal nests, or ice can obstruct proper flow in venting systems

Venting System Maintenance

Regular Inspection

Schedule annual inspections of the entire venting system

Cleaning

Remove any buildup of soot, debris, or corrosion

Repair

Address any issues with joints, supports, or damaged components

4

Documentation

Maintain records of all inspections and maintenance performed

Venting System Performance Testing

Temperature Testing

Measure flue gas temperature to ensure it remains above the dew point

- Use appropriate temperature measuring equipment
- Compare readings to manufacturer's specifications
- Verify temperatures at various points in the system

Draft Testing

Verify proper draft in the venting system

- Use a draft gauge or manometer
- Measure at the draft hood or flue collar
- Compare readings to required specifications

Spillage Testing

Check for flue gas spillage at the draft hood

- Use smoke pencil or match test
- Perform test after 5 minutes of operation
- Test with all exhaust devices operating

Combustion Analysis

Analyze flue gases for proper combustion

- Measure CO, CO2, and O2 levels
- Verify readings are within acceptable ranges
- Adjust appliance if necessary

Key Takeaways for Gas Technicians

Safety First

Always prioritize safety in all venting system installations

Code Compliance

Follow CSA B149.1 requirements for all venting installations

House-as-a-System

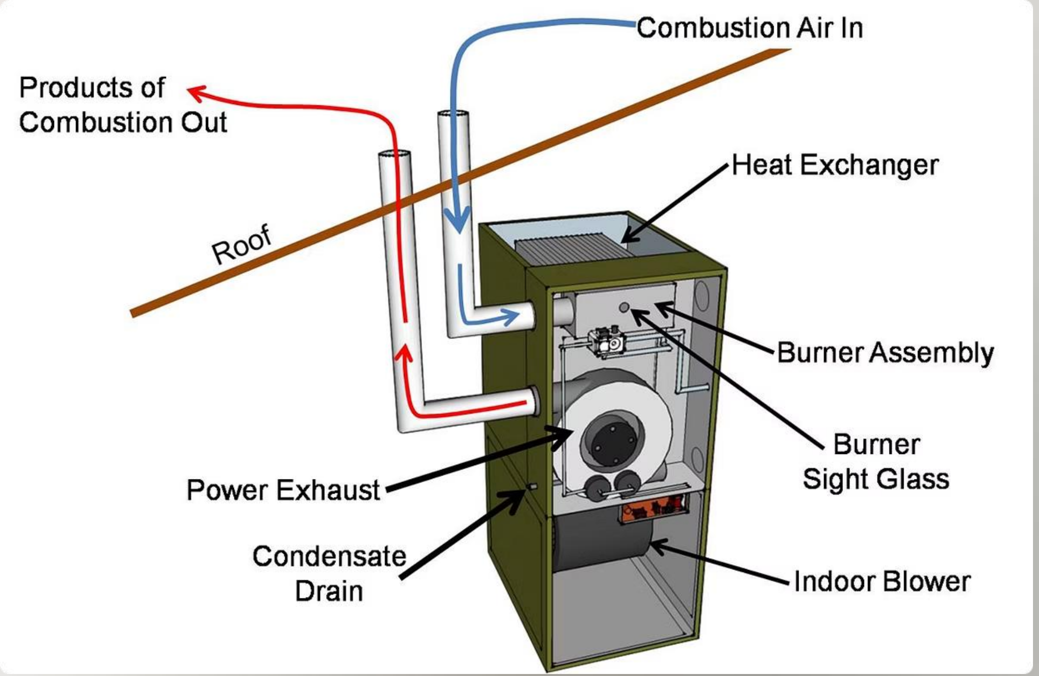
Consider the entire building when designing venting systems

Proper Installation

Use correct techniques and certified components

Thorough Testing

Verify system performance under all operating conditions



CSA Unit 22

Chapter 4
Size venting systems for Category I appliances

CSA B149.1 provides detailed vent sizing tables used for the correct sizing of draft-hood-equipped and fan-assisted appliances. The tables are informative, and CSA B149.1 states that a vented appliance must be attached to a vent or chimney. The vent or chimney action must work to remove the flue gases from the appliance to outdoors. The gas technician/fitter must know how to use these tables, as well as the requirements for specific types of appliances and venting configurations.

Objectives

Interpret vent sizing tables

Learn how to read and understand the various vent sizing tables in CSA B149.1 for different appliance types and configurations.

Use vent sizing tables

Apply the tables correctly to size venting systems for Category I appliances in various installation scenarios.

Key Facts About Vent Sizing

Vent Reduction

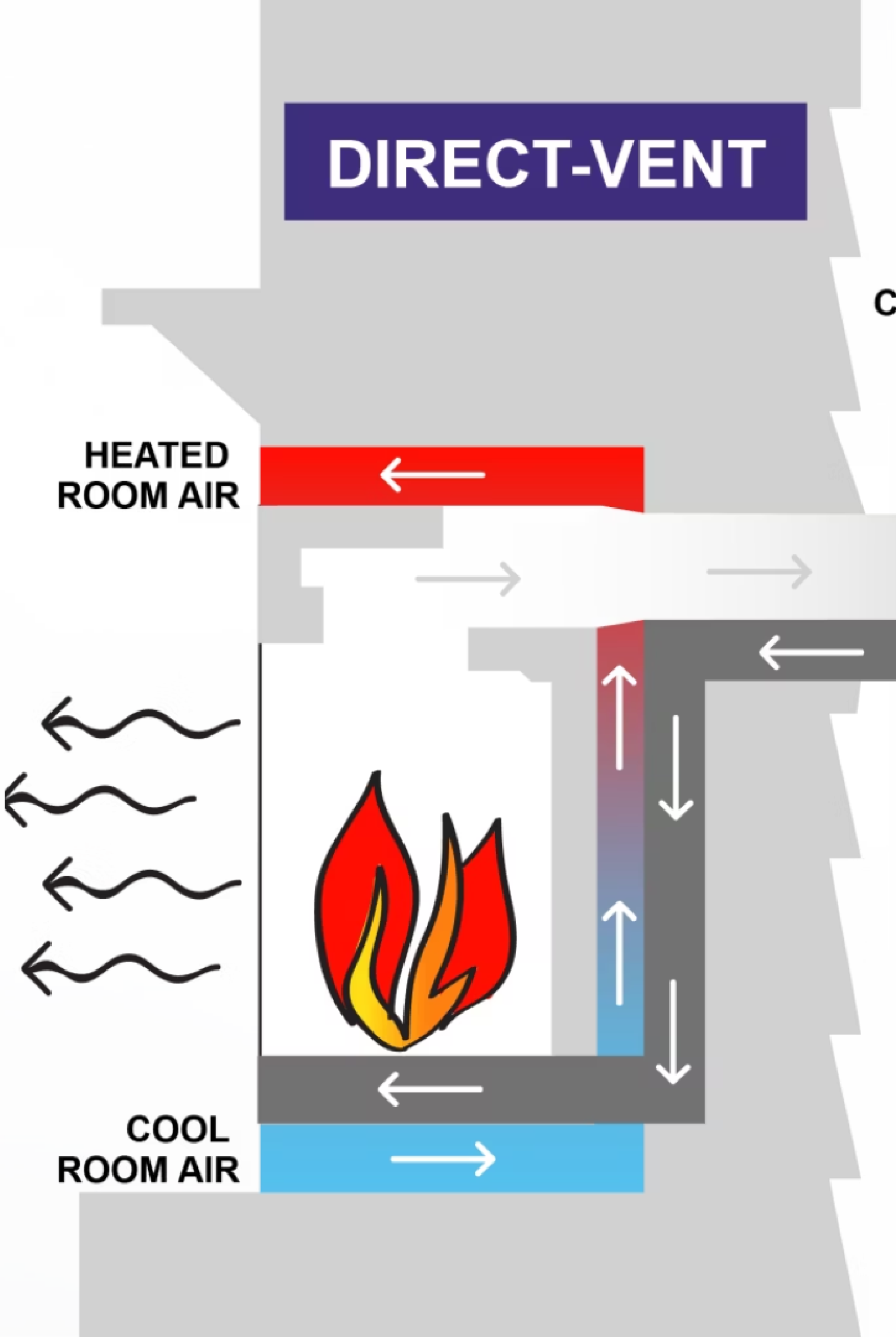
The vent for a fan assisted appliance with a 4" flue collar may be reduced to 3" if determined by the tables.

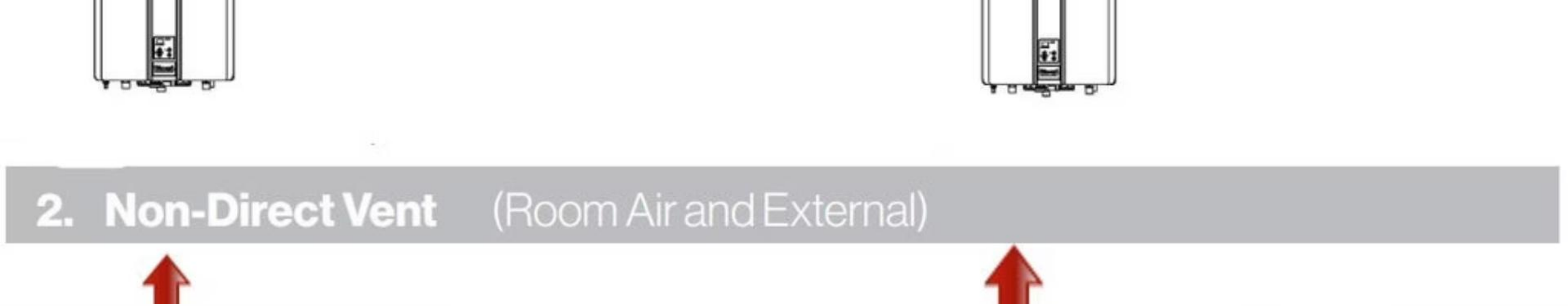
Vent Connector Elbows

A single vented fan-assisted appliance requires 3 elbows for the vent connector. The table capacity needs to be reduced by 15%.

Preferred Pipe Diameter

When the vent table permits more than one diameter of pipe that can be used for a connector or the vent, the smaller connector or vent is preferred.





Capacity Adjustments

Horizontal Common Vent

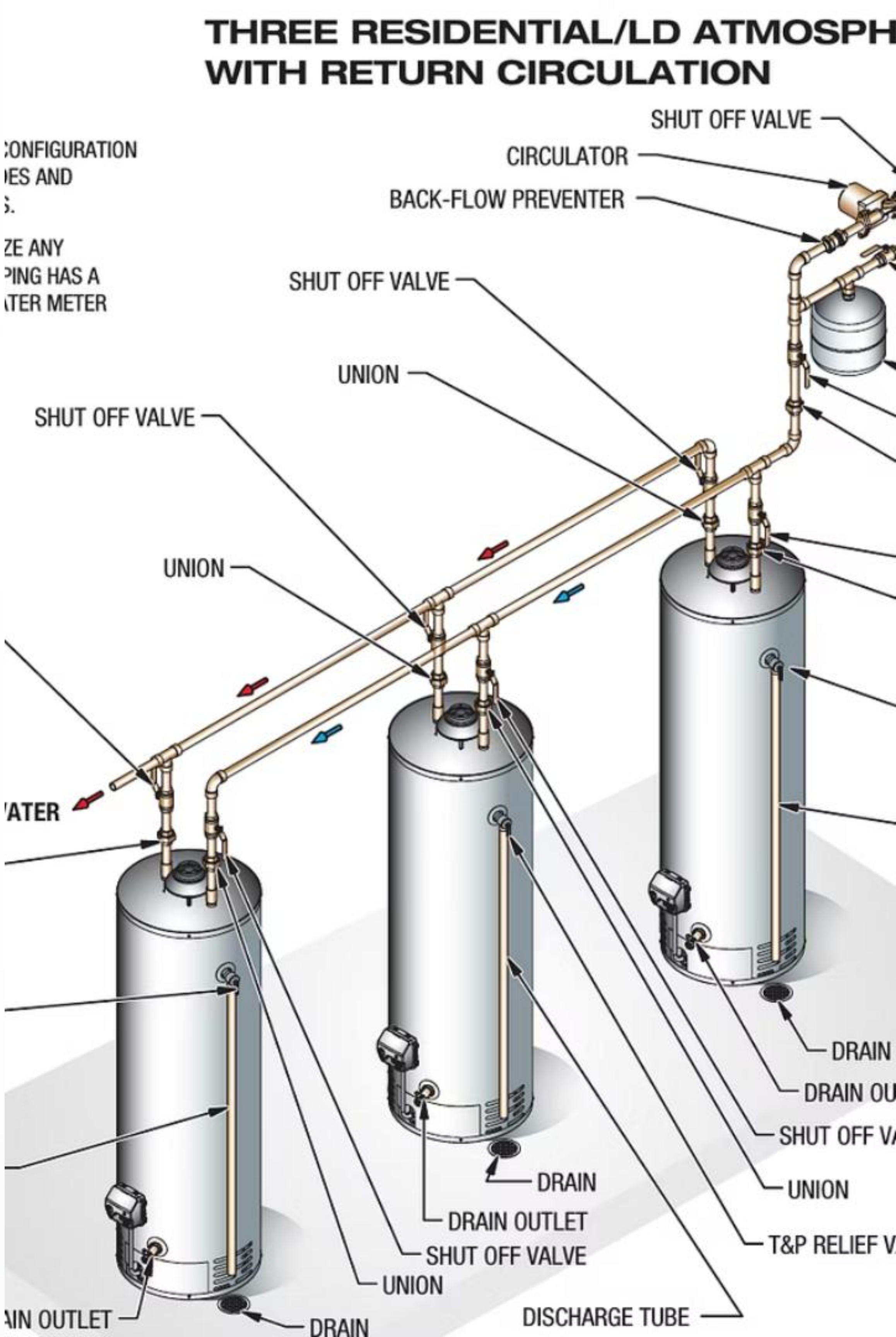
If the vent connectors are connected to a horizontal common vent connector manifold, the common vent capacity table must be reduced by 10%.

Offset Common Vent

If the common vent is offset, the common vent capacity table must be reduced by 20%.

Terminology

Term	Abbreviation	Definition (Symbol)
Informative	-	Non-mandatory



Interpreting Vent Sizing Tables

This section provides an explanation of how to use the vent sizing tables in Annex C of CSA B149.1 for Category I appliance installations.

Main Reasons for Tables

The vent sizing tables were developed to properly size vents serving draft-hood-equipped and fan-assisted appliances (Category I) and to account for the -0.02 inch w.c. (-5 Pa) house depressurization limit.

Important Considerations

The tables are only intended for Category I appliances vented to a Type B vent, a certified chimney liner, or as permitted, a tile-lined chimney.

VENT DIAMETER—							
4			5			6	
APPLIANCE INPUT RATING IN							
FAN		NAT	FAN		NAT	FAN	
Min	Max	Max	Min	Max	Max	Min	Max
0	213	128	0	374	220	0	587
13	166	112	14	283	185	18	432
28	160	108	36	275	176	45	421
37	150	102	48	262	171	59	405
44	141	96	57	249	163	70	389
53	132	90	66	237	154	80	374
73	113	NA	88	214	NA	104	346
0	216	134	0	397	232	0	633
11	183	122	14	320	206	15	497
27	177	119	35	312	200	43	487
35	168	114	45	299	190	56	471
42	158	NA	54	287	180	66	455
50	149	NA	63	275	169	76	440
59	131	NA	84	250	NA	99	410
0	218	NA	0	407	NA	0	665
10	194	NA	12	354	NA	13	566

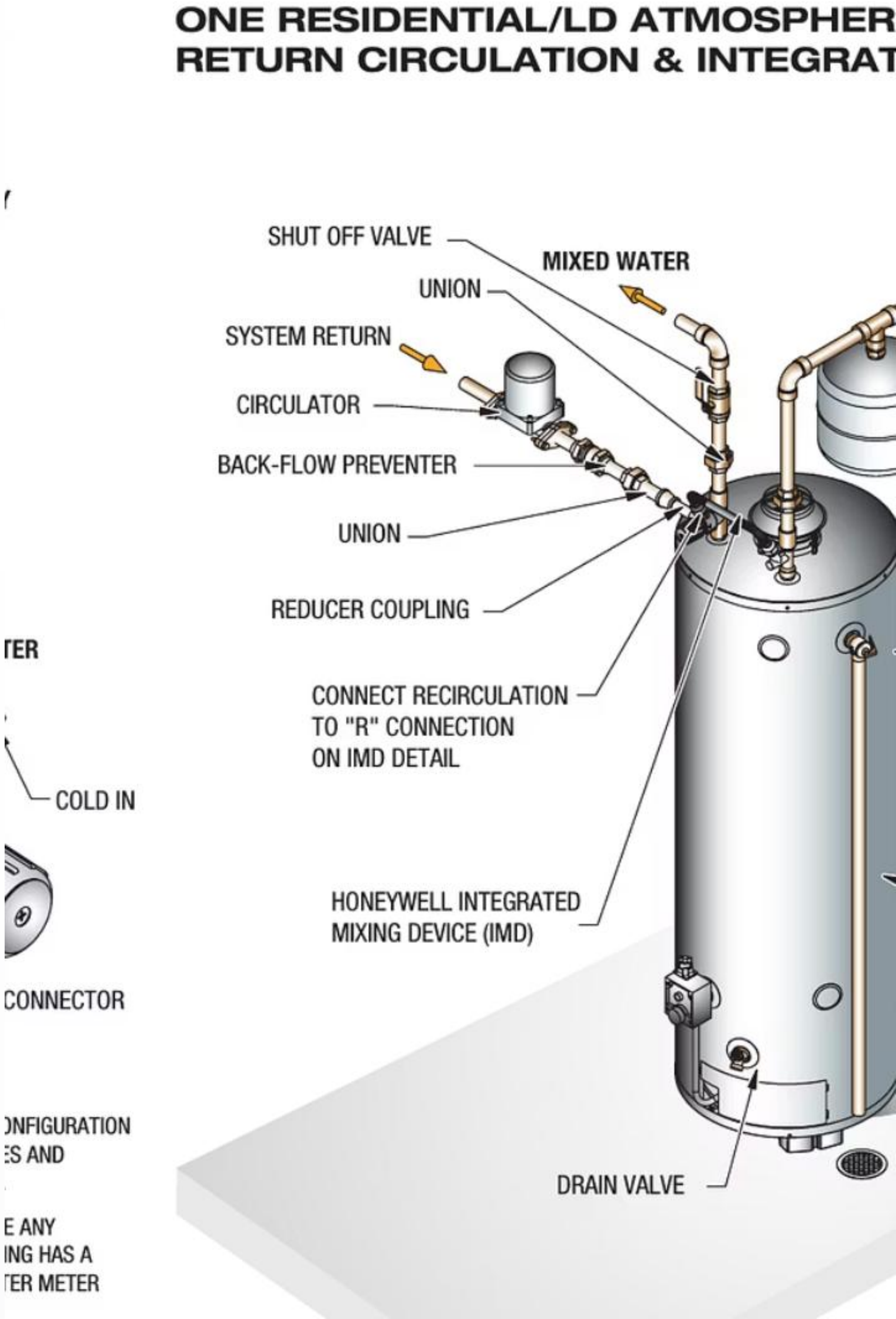
Using Vent Sizing Tables

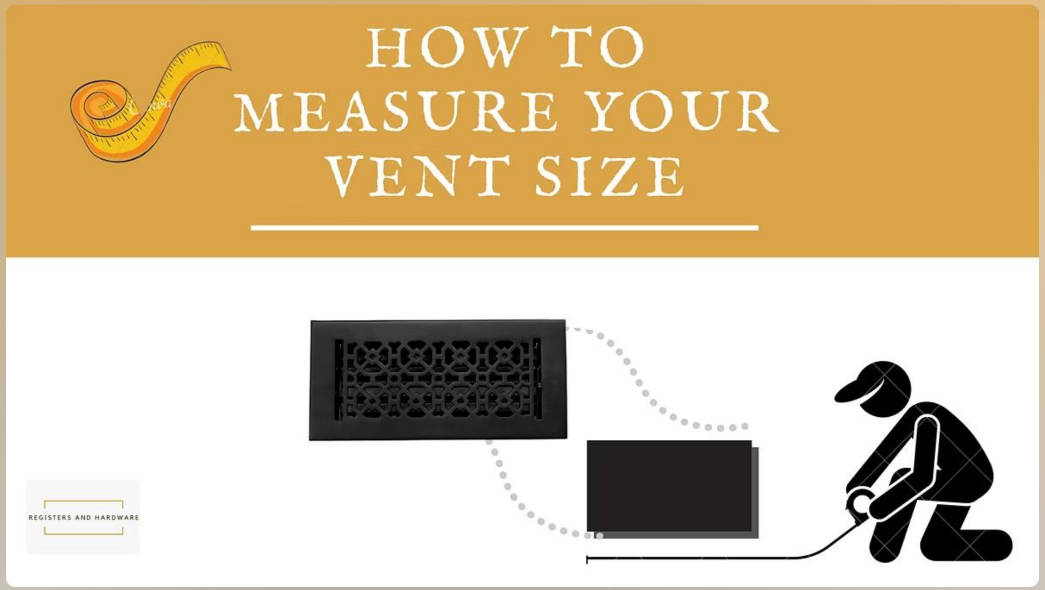
Alternative Venting Methods

For all other methods of venting, follow the manufacturer's certified installation instructions, or consult the local inspection authority, propane distributor, or gas utility.

Table Limitations

Whenever the tables do not show a particular venting system arrangement, this means that use of the tables is not permitted. The venting system, if permitted by the authority having jurisdiction, must be designed and approved.





Handling Non-Exact Table Values

Interpolation

You can interpolate the table as described in GVR C.2.15 when the actual installation values don't exactly match table values.

Worst Case Scenario

You can use the values in the table provided you select table values that would provide inferior venting compared to the actual installation. Selecting table values of lesser heights and rises and longer laterals ensures the actual installation will operate at a greater capacity than indicated by the tables.

Understanding Table C.1

Table C.1 shows the capacity of Type B double-wall vents with Type B double-wall vent connectors serving a single Category I appliance.

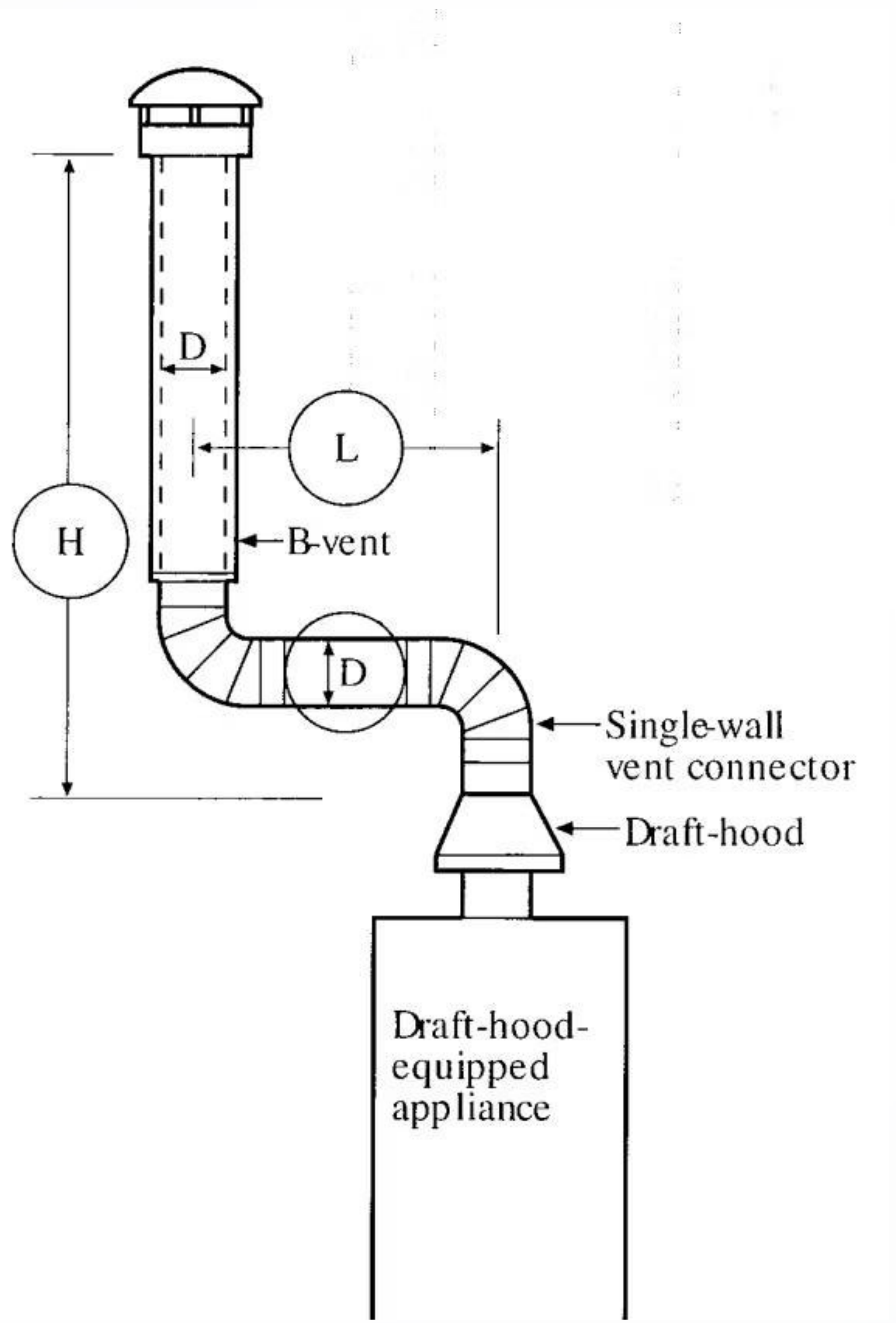
Key Components

- Vent and vent connector diameter (D) in inches
- Lateral length (L) in feet
- Height (H) in feet
- Appliance input rating in thousands of Btu/h

Column Types

- FAN columns for fan-assisted appliances
- NAT columns for natural draft appliances
- Min/Max columns indicate allowable input ranges
- DP column for depressurization scenarios

Example A: Single Fan-Assisted Appliance



Find Appropriate Range

Determine Vent Size

Look up the column in which this range appears to obtain

Single Fan-Assisted Appliance Connected to a Type B Vent

The safe and effective venting of fan-assisted appliances is one of the main reasons for the current version of the vent sizing tables. Fan-assisted appliances are more susceptible to condensation in the vent because they produce a lower volume and temperature of flue gas than draft-hood-equipped appliances. Take care to size their venting properly.

Table C.1

Use when you use a Type B vent connector

Table C.2

Use in situations in which a single wall vent connector is used

Single Draft-Hood-Equipped Appliance Connected to a Type B Vent

You may also use Tables C.1 and C.2 to size a venting system serving a single draft-hood-equipped appliance. However, instead of the FAN columns, use the NAT columns.

MAX Column

Applies to situations where an appliance is being installed in a leaky building without air exhausting appliances or equipment

DP Column

Should be used practically all of the time. The DP column capacities were developed to account for the maximum 0.02 inch w.c. (5 Pa) negative pressure (depressurization).

Example B: Draft-Hood-Equipped Appliance

Identify Parameters

A 120 MBtu/h pool heater is being installed in a shed. It has a height of 10 ft, and a single-wall lateral vent connector with a length of 2 ft.

Consult Table C.2

Find the row with a height of 10 ft. Within the next column, find the row with a lateral length of 2 ft.

Find Appropriate Capacity

Proceed across until you find a MAX capacity greater than or equal to 120 MBtu/h under the NAT column. The MAX column is used because the shed is a leaky structure with no air exhausting appliances.

Determine Vent Size

The appropriate capacity is 128 MBtu/h. Look up the column in which this capacity appears to obtain the vent and vent connector diameter. A 5 inch or larger diameter is required.

Single Draft-Hood-Equipped Appliance Connected to a Tile-Lined Chimney

There are a number of cases where replacing an older appliance that is connected to a tile-lined masonry chimney is necessary. In these situations, Tables C.5 and C.6 may be used, provided these requirements are satisfied:

Chimney Condition

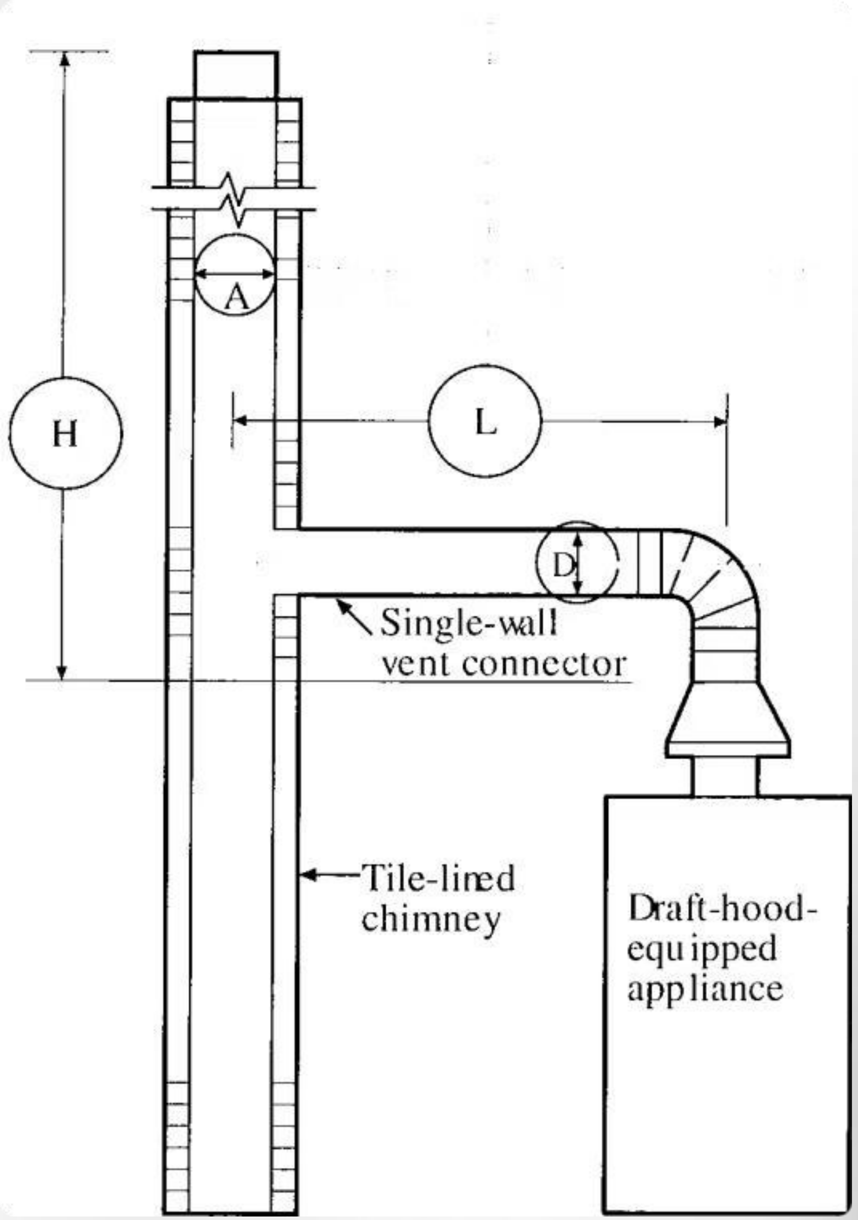
The chimney must be lined and in good condition

Chimney Location

The chimney must be warm - it cannot be located on an exterior wall

Liner Size

The chimney liner must not be oversized, causing excessive condensation



Example C: Draft-Hood-Equipped Appliance with Tile-Lined Chimney

Identify Parameters

An 80 MBtu/h replacement boiler is being installed in a bungalow with an internal, tile-lined masonry chimney. It has a height of 15 ft, and a single-wall lateral vent connector with a length of 2 ft. The chimney and its 8 × 8 inch liner are in good condition.

Determine Vent Connector Size

Using Table C.6, find the row with a height of 15 ft and a lateral length of 2 ft. Proceed across until you find a DP capacity greater than 80 MBtu/h under the NAT column. The appropriate capacity indicates a minimum vent connector diameter of 5 inches.

Check Chimney Liner Size

The area of the 8 × 8 inch liner is 42.7 square inches, which is between the minimum (28) and maximum (137) square inches, so the liner is acceptable.

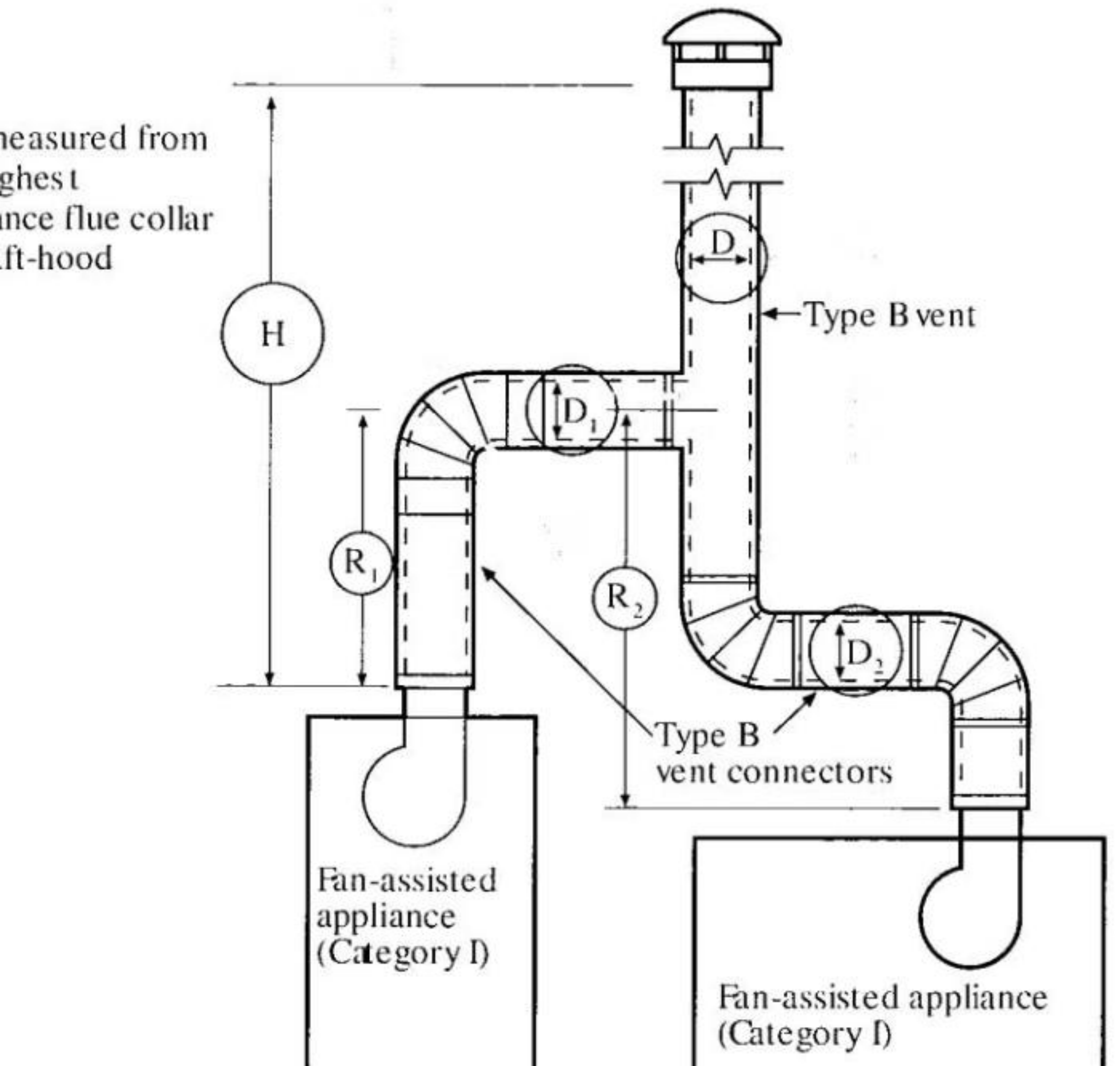
Verify Capacity Limit

For an input of 80 MBtu/h, the limit is 80 × 1.25 = 100 MBtu/h. The listed capacity of the chimney is 97 MBtu/h - the chimney liner is still okay.

TABLE C.3

Capacity of Type B double-wall vents with Type B double-wall vent connectors serving two or more Category I appliances

Vent height H (ft)	Vent connector rise R (ft)	Vent connector diameter–D (inches): 3 — Appliance input rating limits in thousands of Btu/h				4				5		
		FAN		NAT		FAN		NAT		FAN		NAT
		Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max
20	1	21	54	31	28	33	99	56	50	46	157	87
	2	22	57	37	33	34	105	66	59	48	167	[illegible]
	3	23	60	42	38	35	110	74	67	50	176	[illegible]



Two or More Fan-Assisted Appliances Connected to a Type B Common Vent

You may perform the sizing of vent connectors and the common vent serving two or more fan-assisted appliances using Code Tables C.3 and C.4.

Table C.3

Use when you use a Type B vent connector

Table C.4

Use in situations where a single-wall vent connector is used

Example D: Two Fan-Assisted Appliances

Identify Parameters

A fan-assisted furnace (40 MBtu/h, vent connector rise of 2 ft) and a fan-assisted boiler (80 MBtu/h, vent connector rise of 3 ft) are being installed with a Type B common vent with a height of 20 ft.

Size Vent Connectors

For the furnace, find the row with a height of 20 ft and rise of 2 ft. The appropriate range is 22 to 57 MBtu/h, requiring a 3 inch vent connector. For the boiler, a 4 inch vent connector is required.

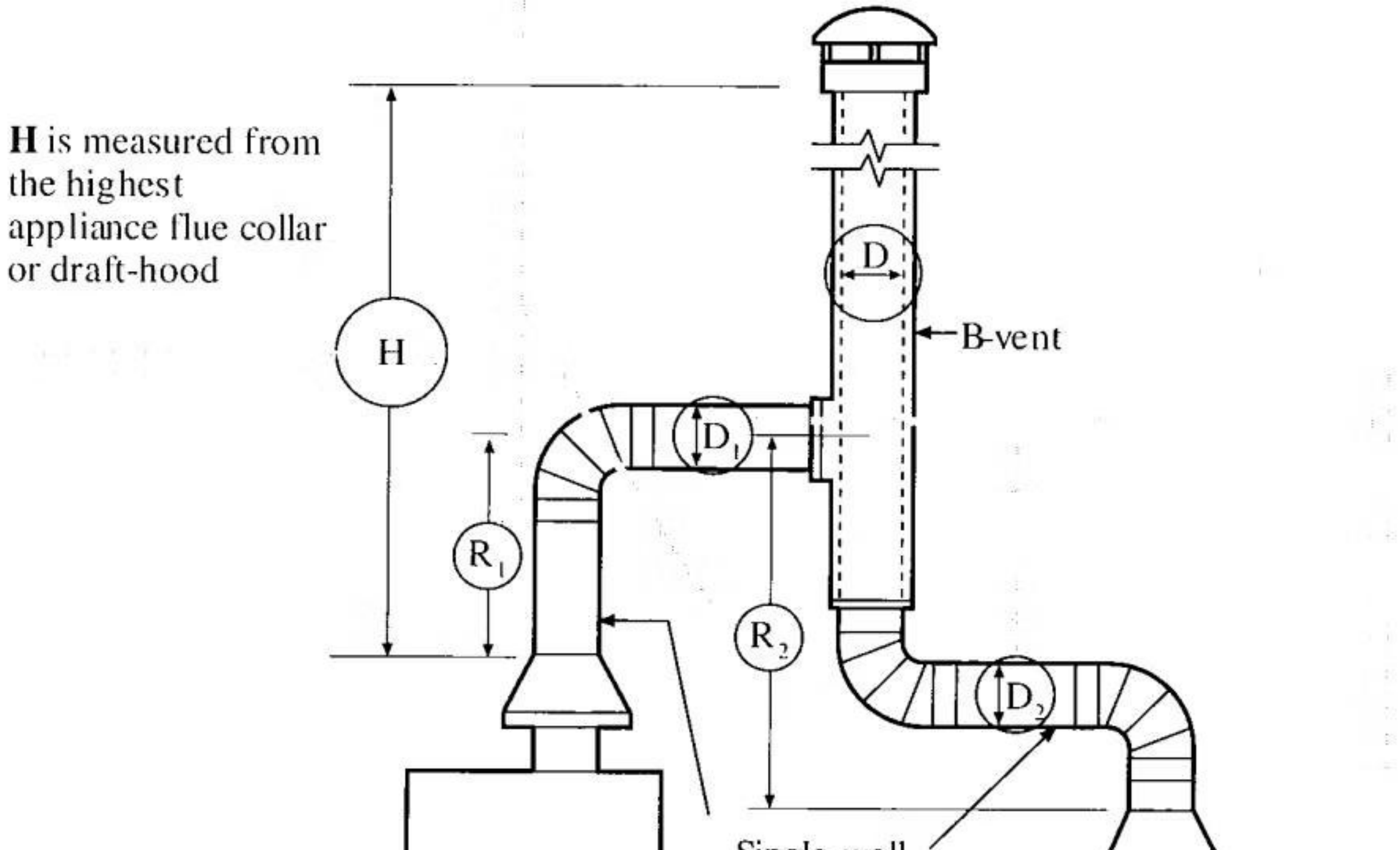
Size Common Vent

The combined capacity is 40 + 80 = 120 MBtu/h. Find the first FAN + FAN column equal to or greater than 120. A capacity of 136 MBtu/h corresponds to a 4 inch common vent size.

Two or More Draft-Hood-Equipped Appliances Connected to a Type B Common Vent

TABLE C.4
Capacity of Type B double-wall vents with single-wall vent connectors serving two or more Category I appliances

Vent height H (ft)	Vent connector rise R (ft)	Vent connector diameter–D (inches): 3				4				5			
		Appliance input rating limits in thousands of Btu/h											
		FAN		NAT		FAN		NAT		FAN		NAT	
		Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP
30	1	47	60	31	29	77	110	57	53	113	175	89	83
	2	50	62	37	34	81	115	67	62	117	185	106	99
	3	54	64	42	39	85	119	76	71	122	193	120	112



Example E: Two Draft-Hood-Equipped Appliances

Identify Parameters

A draft-hood-equipped water heater (40 MBtu/h, vent connector rise of 2 ft) and a draft-hood-equipped boiler (80 MBtu/h, vent connector rise of 3 ft) are being installed with a Type B common vent with a height of 30 ft.

Size Water Heater Vent Connector

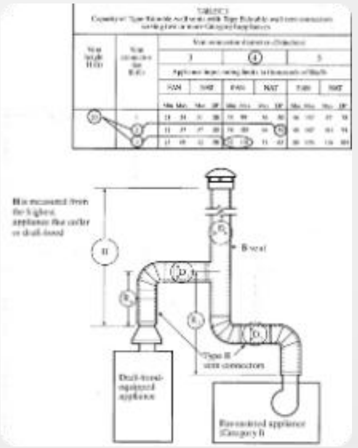
Find the row with a height of 30 ft and rise of 2 ft. The appropriate capacity is 62 MBtu/h, requiring a 4 inch vent connector.

Size Boiler Vent Connector

Using a rise of 3 ft and an input of 80 MBtu/h, the appropriate capacity is 112 MBtu/h, requiring a 5 inch vent connector.

Size Common Vent

The combined capacity is 40 + 80 = 120 MBtu/h. The DP (N+N) column lists a capacity of 166 MBtu/h corresponding to a 5 inch common vent size.



A Fan-Assisted Appliance and a Draft-Hood-Equipped Appliance Connected to a Type B Common Vent

Perform the sizing of vent connectors and the common vent serving a combination of fan-assisted and draft-hood-equipped appliances using Code Table C.3 or C.4.

Table C.3

Use when you use Type B vent connectors

Table C.4

Use in situations where single-wall vent connectors are used

Example F: Fan-Assisted and Draft-Hood-Equipped Appliances

Identify Parameters

A draft-hood-equipped water heater (40 MBtu/h, vent connector rise of 2 ft) and a fan-assisted boiler (80 MBtu/h, vent connector rise of 3 ft) are being installed with a Type B common vent with a height of 20 ft.

Size Water Heater Vent Connector

Find the row with a height of 20 ft and rise of 2 ft. The capacity is 59 MBtu/h, requiring a 4 inch vent connector.

Size Boiler Vent Connector

Using a rise of 3 ft and an input of 80 MBtu/h, a 4 inch vent connector is required.

Size Common Vent

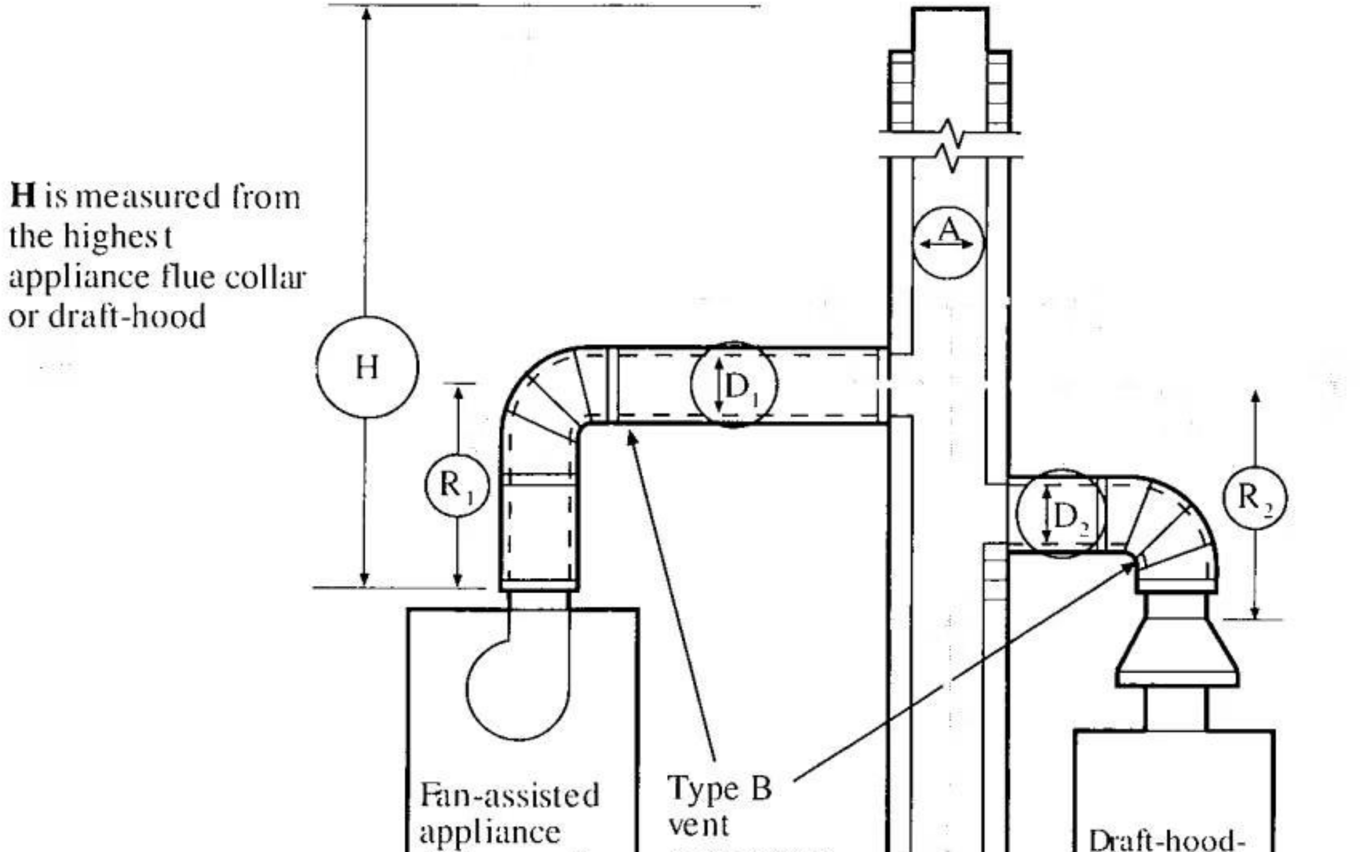
The combined capacity is 40 + 80 = 120 MBtu/h. The DP (F+N) column lists a capacity of 165 MBtu/h corresponding to a 5 inch common vent size.

A Fan-Assisted Appliance and a Draft-Hood-Equipped Appliance Connected to a Tile-Lined Chimney

Example C

TABLE C.7
Capacity of masonry chimney with Type B double-wall vent connectors serving two or more Category I appliances

Vent height H (ft)	Vent connector rise R (ft)	Vent connector diameter–D (inches)											
		3				4				5			
		Appliance input rating limits in thousands of Btu/h											
		FAN		NAT		FAN		NAT		FAN		NAT	
		Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP
30	1	24	54	25	23	37	111	48	45	52	192	82	76
	2	25	60	32	30	38	122	58	54	54	208	95	88
	3	26	64	36	33	40	131	66	61	56	221	107	100



Example G: Oversized Chimney Solution

When a chimney is determined to be oversized, a certified liner or B-vent must be installed. This is a common situation when replacing older appliances connected to a tile-lined masonry chimney.

Important Considerations

In most practical cases, because of the large size of typical chimney flues, venting an appliance to a tile-lined chimney is not permissible or advisable, and in many jurisdictions, this practice is prohibited.

Fan-Assisted Appliance Restriction

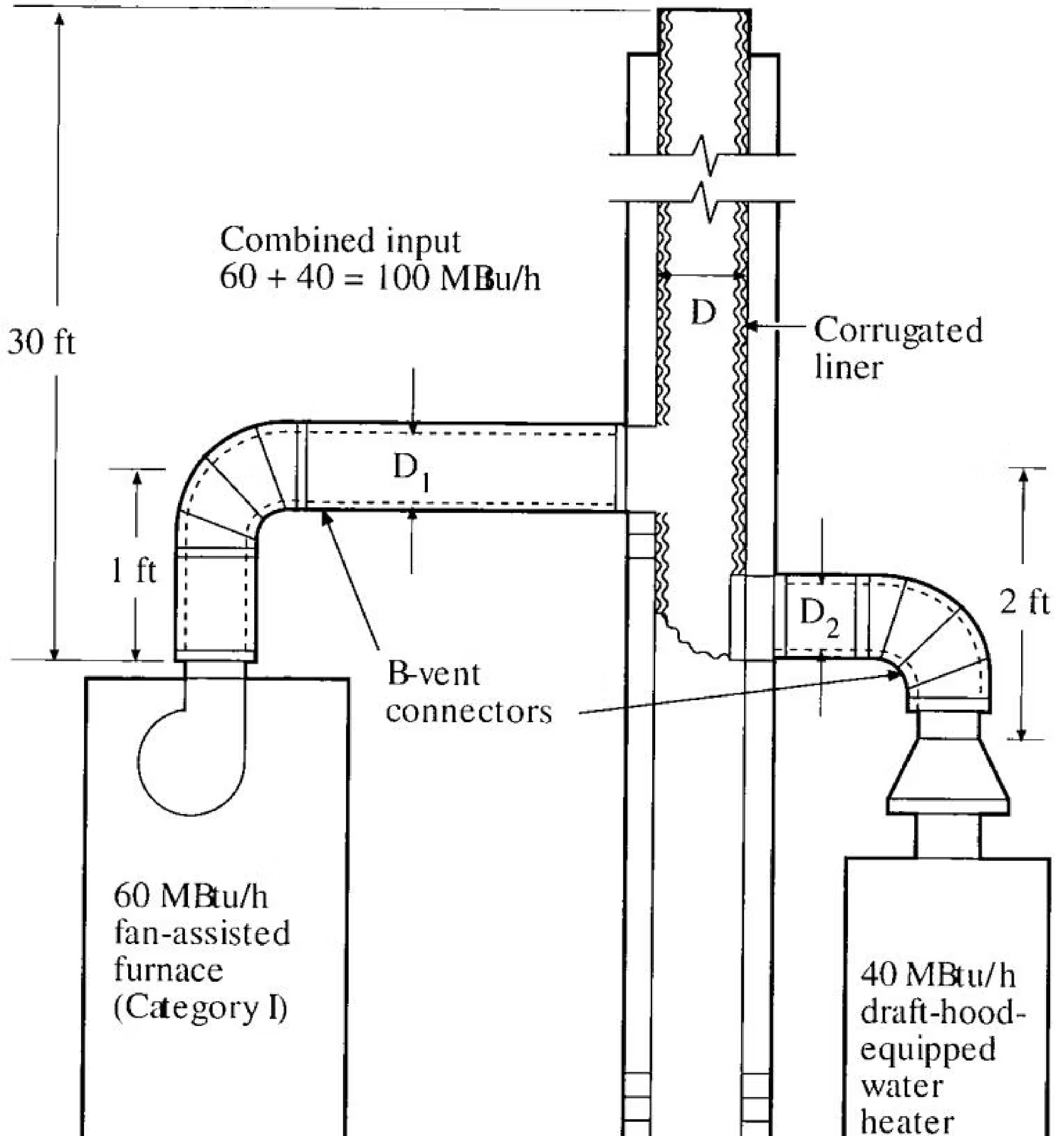
The Code also prohibits the venting of a single fan-assisted appliance to a tile-lined chimney because of the potential for excessive condensation.

Local Consultation

Consult with your local utility or authority having jurisdiction for specific requirements in your area.

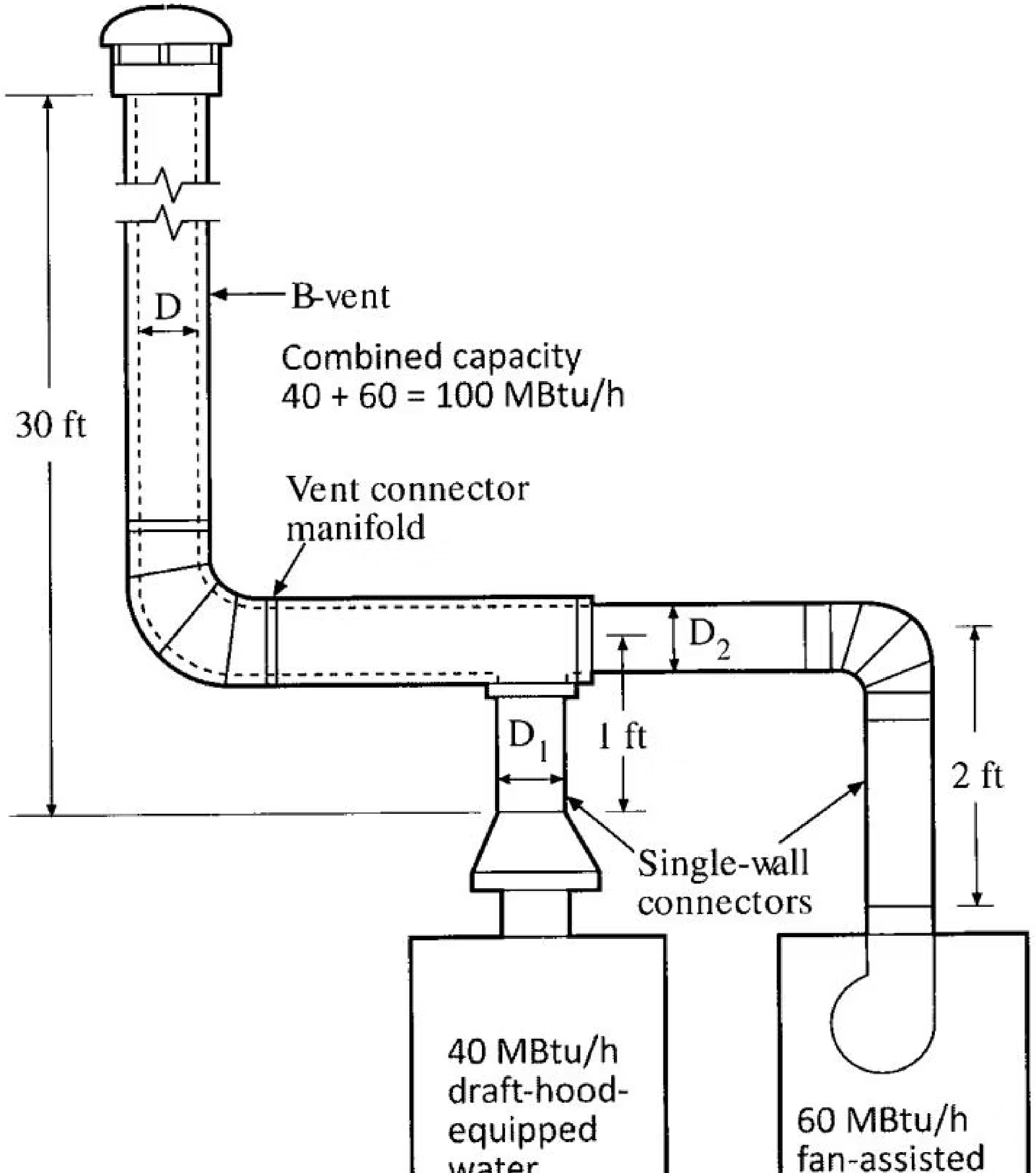
Fan-Assisted and Draft-Hood-Equipped Appliances with Type B Vent Connectors to Certified Corrugated Liner

Figure 4-16
Example 9



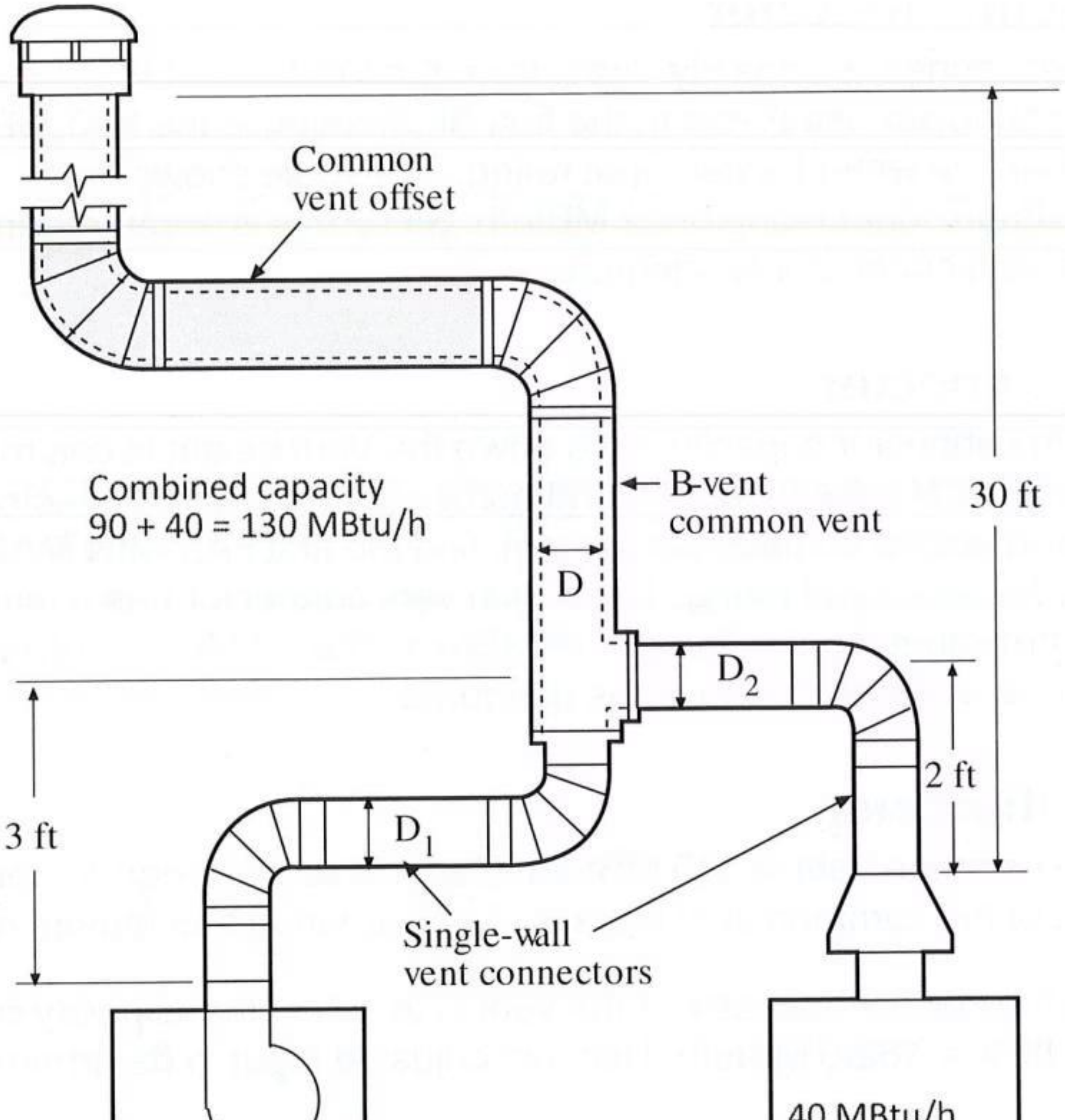
Fan-Assisted and Draft-Hood-Equipped Appliances with Type B Vent Connector Manifold to Common Vent

Figure 4-17
Example 10



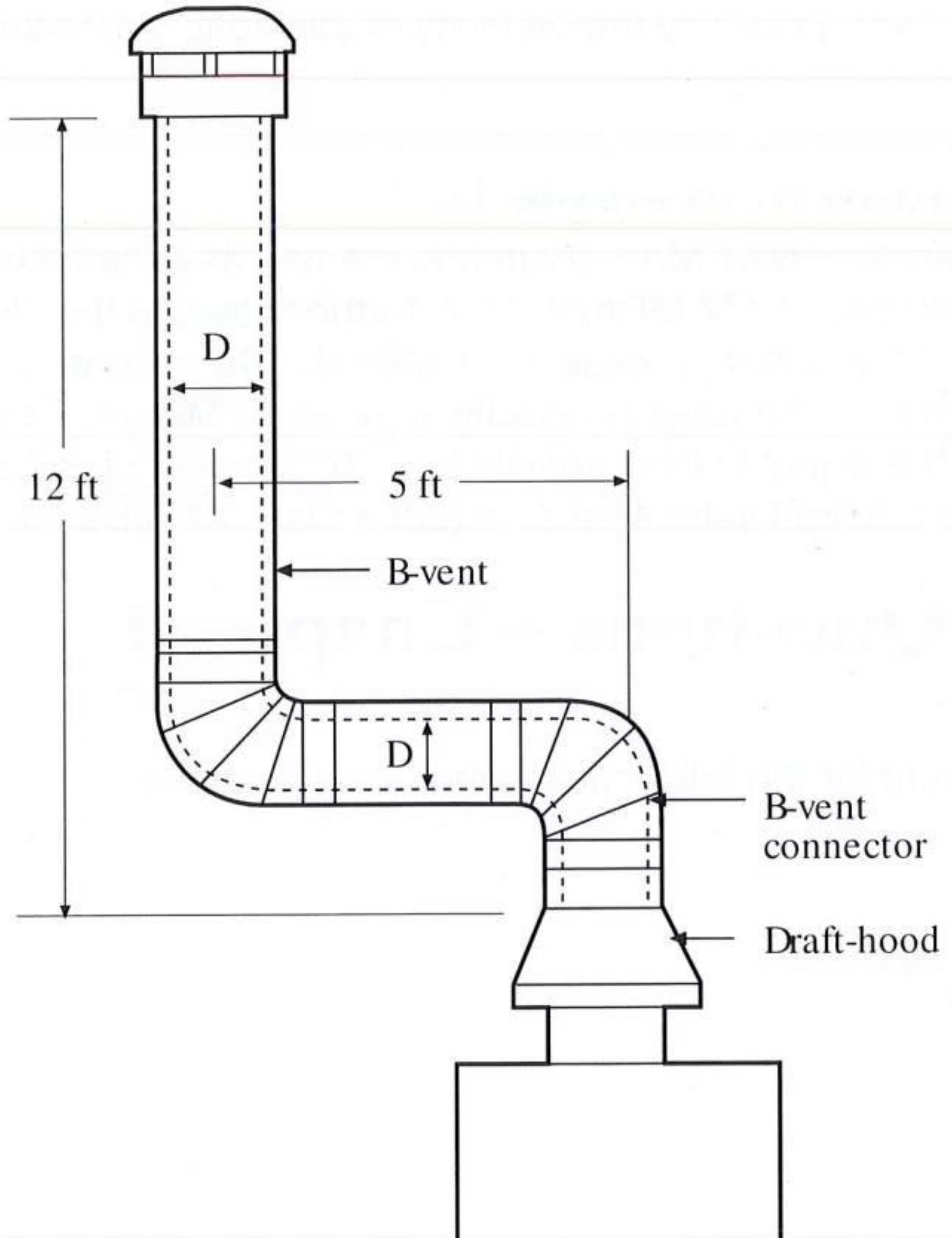
Fan-Assisted and Draft-Hood-Equipped Appliances with Single-Wall Vent Connectors to Common B-Vent with Offset

Figure 4-18
Example 11



Interpolating Between Table Values

Figure 4-19
Example 12



Sizing a Venting System: Prerequisites

The vent sizing tables in CSA B149.1 are based on two basic prerequisites that must be satisfied before the tables can be applied:

House Depressurization Limit

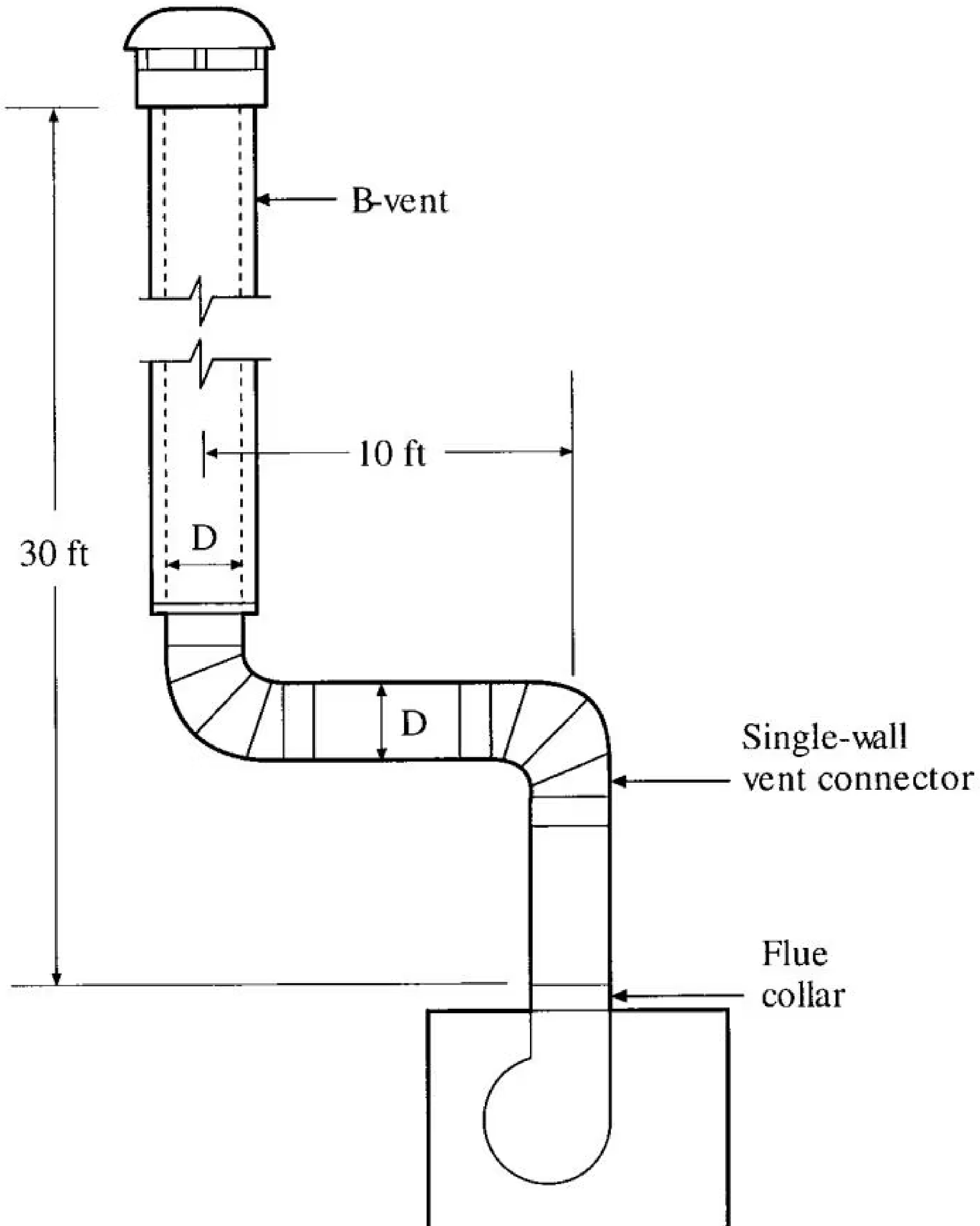
The building where the installation of the appliances is to take place must not develop depressurization greater than 0.02 inch w.c. (5 Pa), the House Depressurization Limit (HDL). If the use of HDL cannot lead to a reliable control of house pressures, do not install fan-assisted and draft-hood appliances, and vent sizing tables thus do not apply.

Venting System Layout

The layout of the venting system must fall within the limits of the vent sizing tables in terms of vent height, length of laterals, vent connector rise, and vent sizes. If any aspect of the venting system exceeds these limitations, do not use the venting tables, as the system must be designed according to the approved practices.

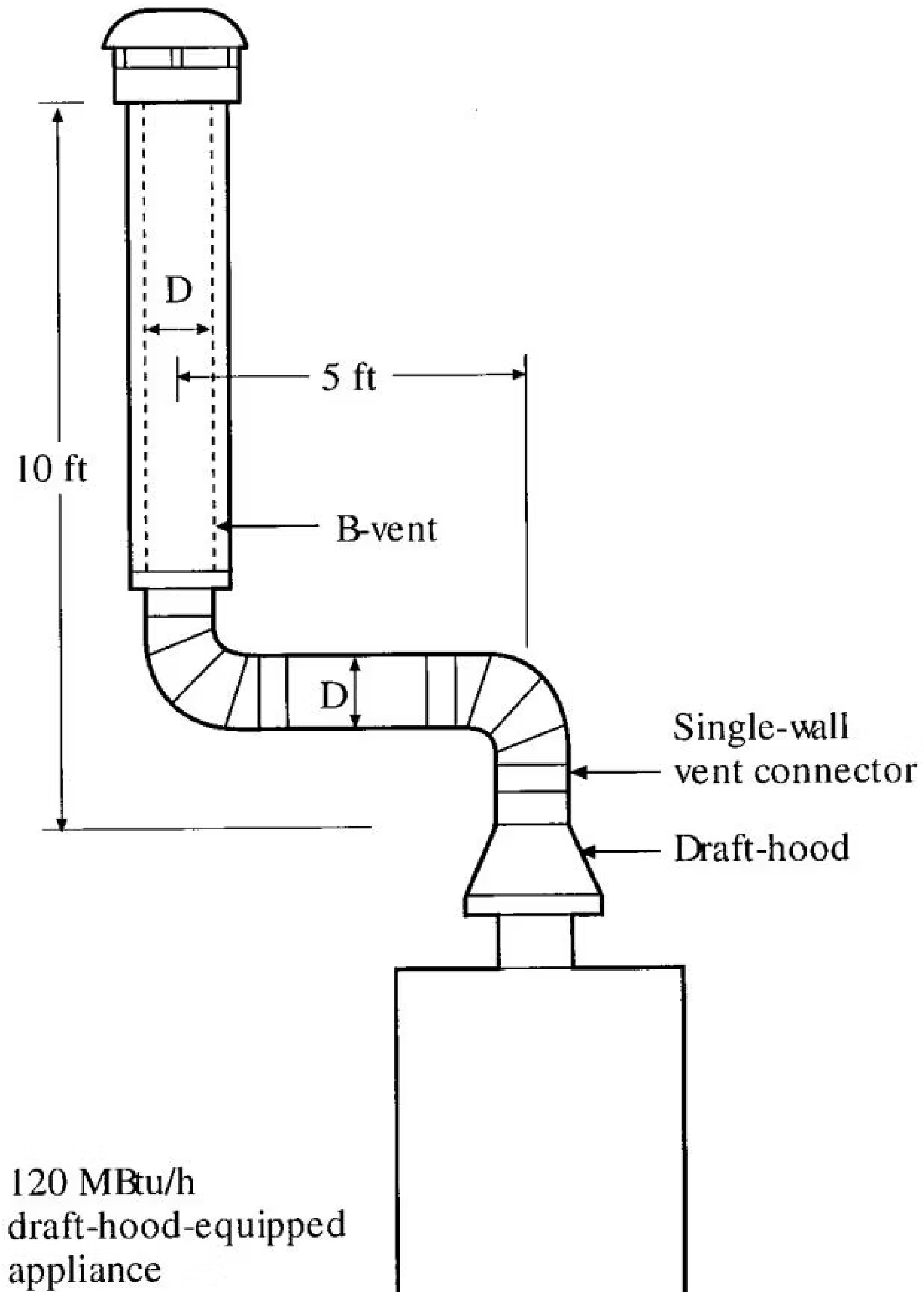
Example 1: Fan-Assisted Appliance with Single-Wall Vent Connector to B-Vent

Figure 4-8
Example 1

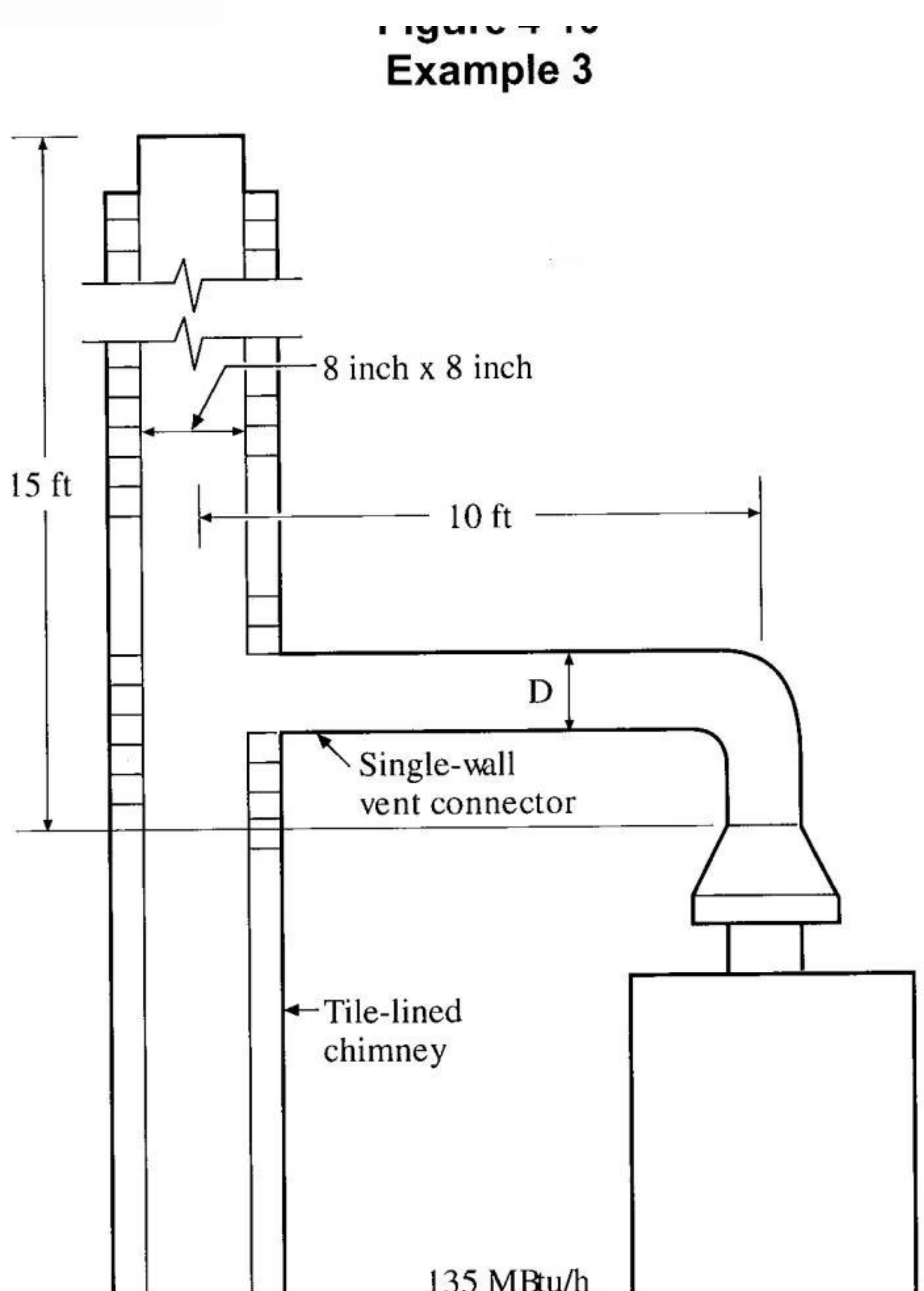


Example 2: Draft-Hood-Equipped Appliance with Single-Wall Vent Connector to B-Vent

Figure 4-9
Example 2

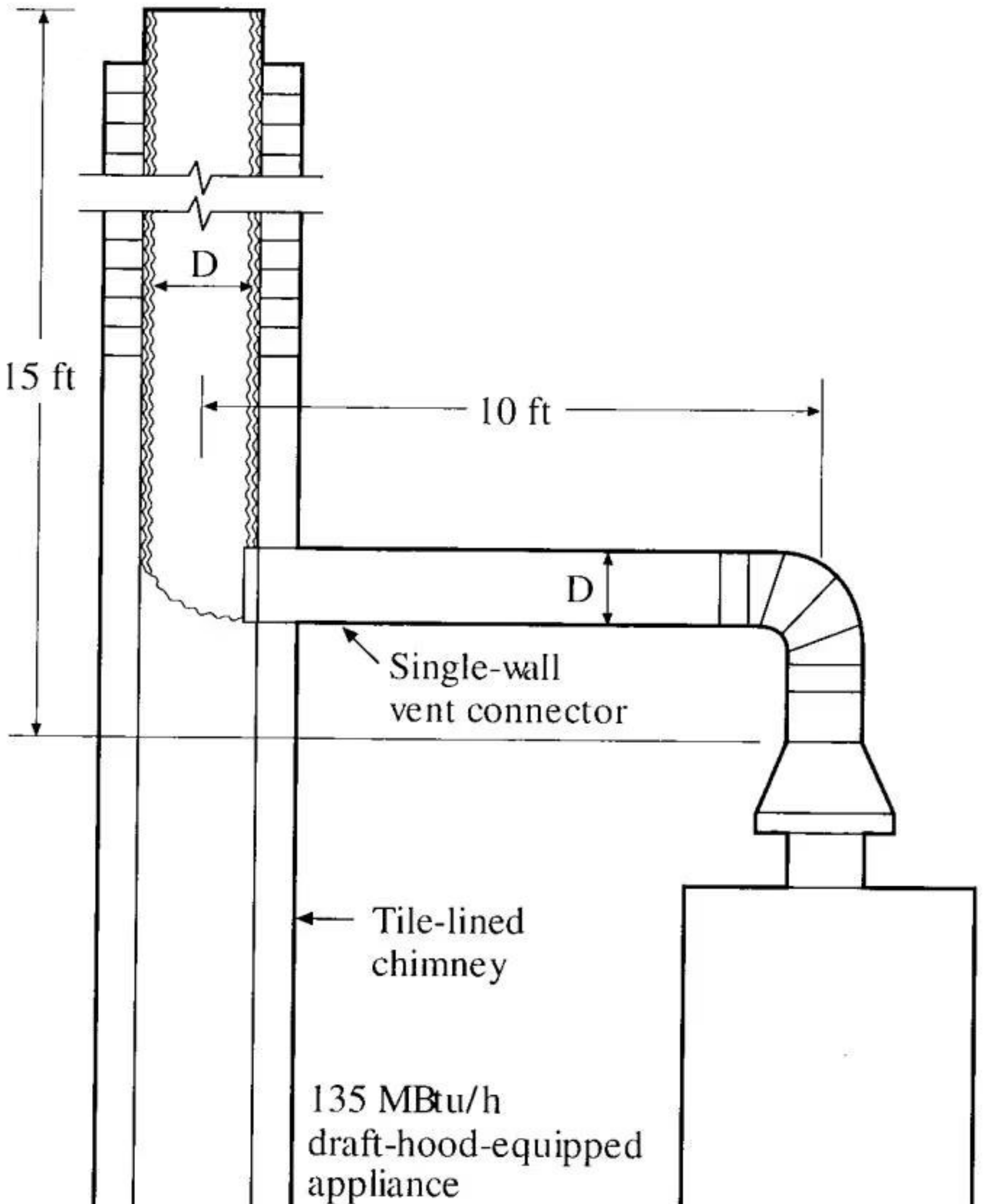


Example 3: Draft-Hood-Equipped Appliance with Single-Wall Vent Connector to Tile-Lined Chimney

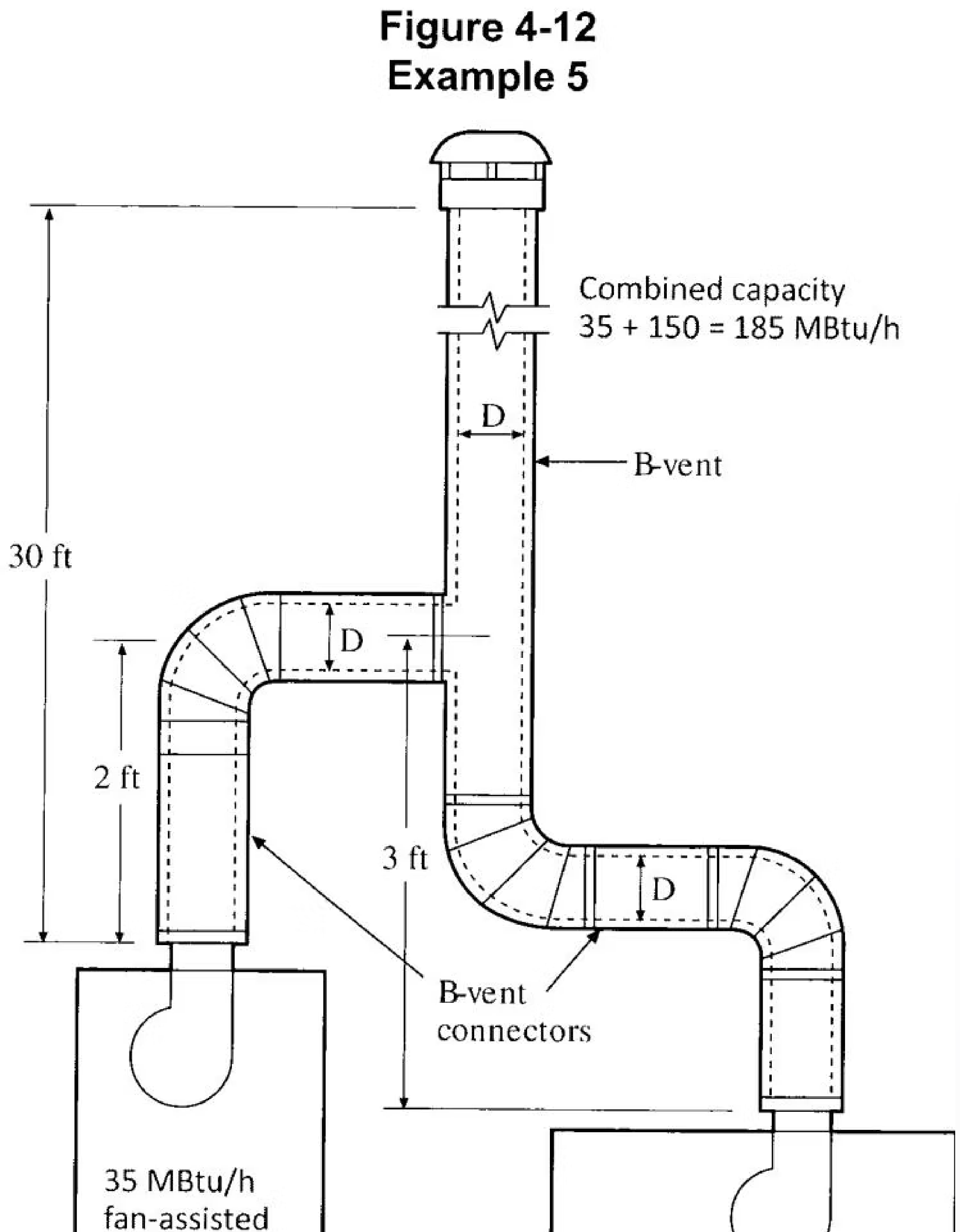


Example 4: Single Draft-Hood-Equipped Appliance with Single-Wall Vent Connector to Certified Corrugated Liner

Figure 4-11
Example 4

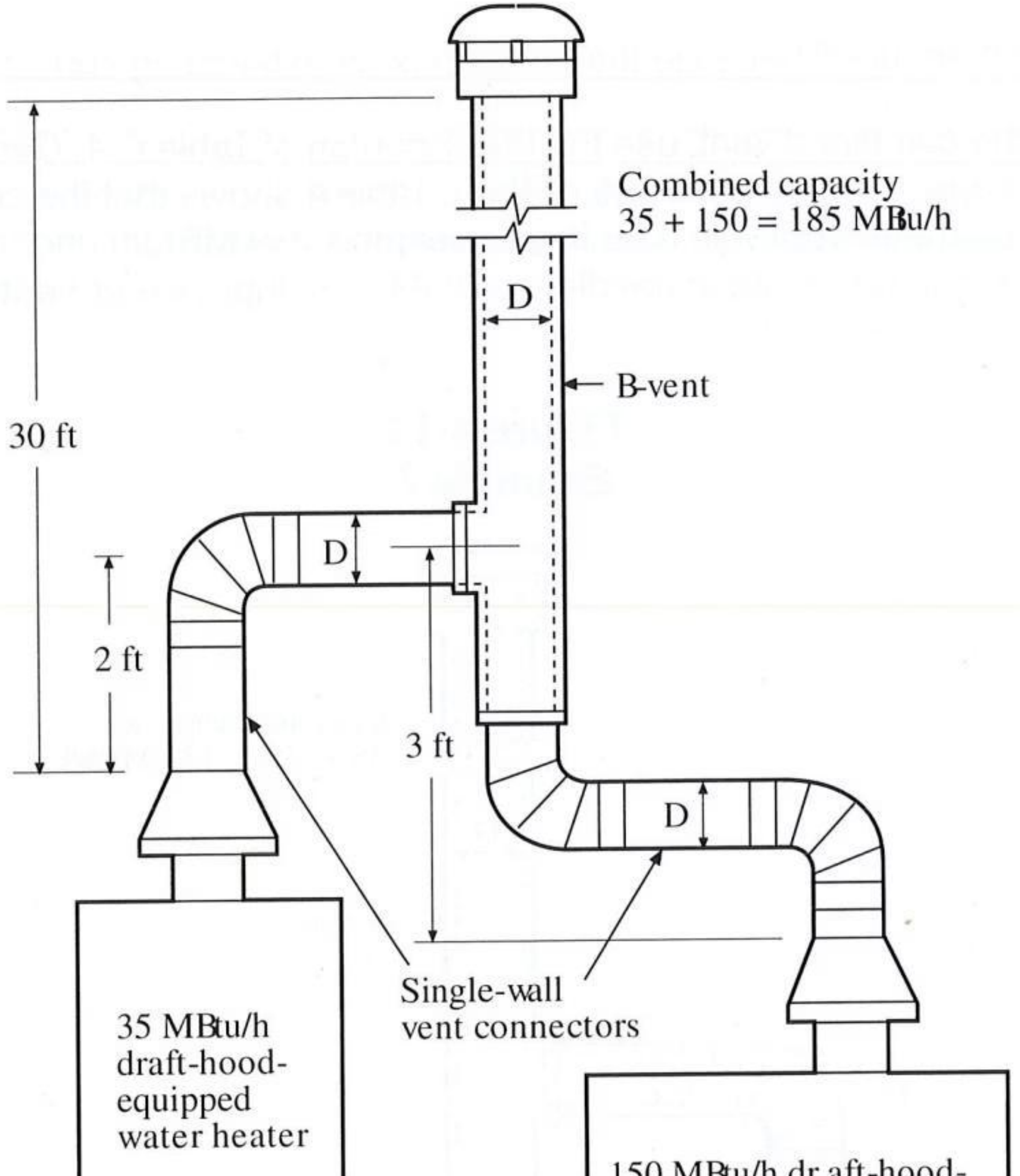


Example 5: Two Fan-Assisted Appliances with Type B Vent Connectors to Common B-Vent



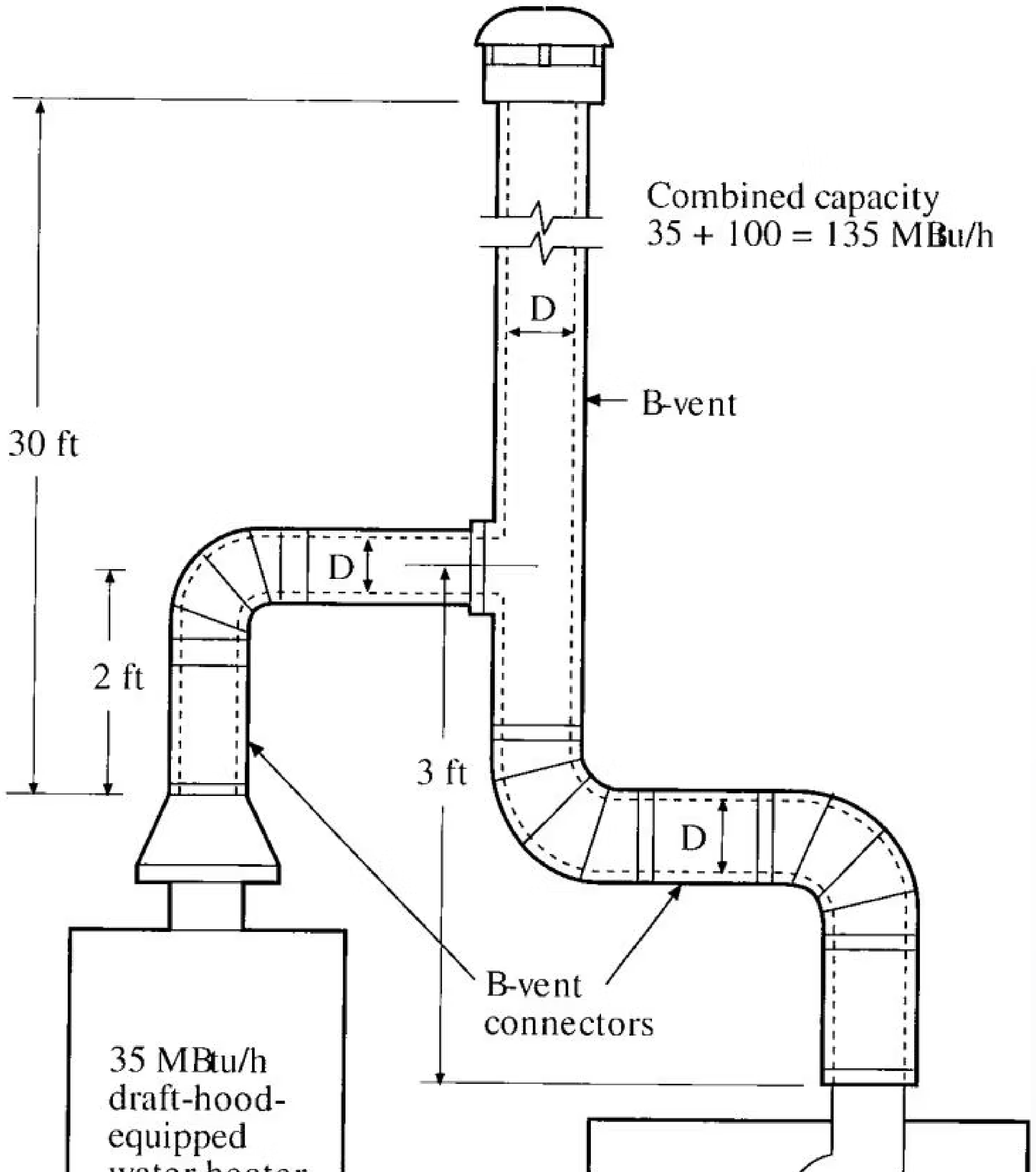
Example 6: Two Draft-Hood-Equipped Appliances with Single-Wall Vent Connectors to Common B-Vent

Figure 4-13
Example 6



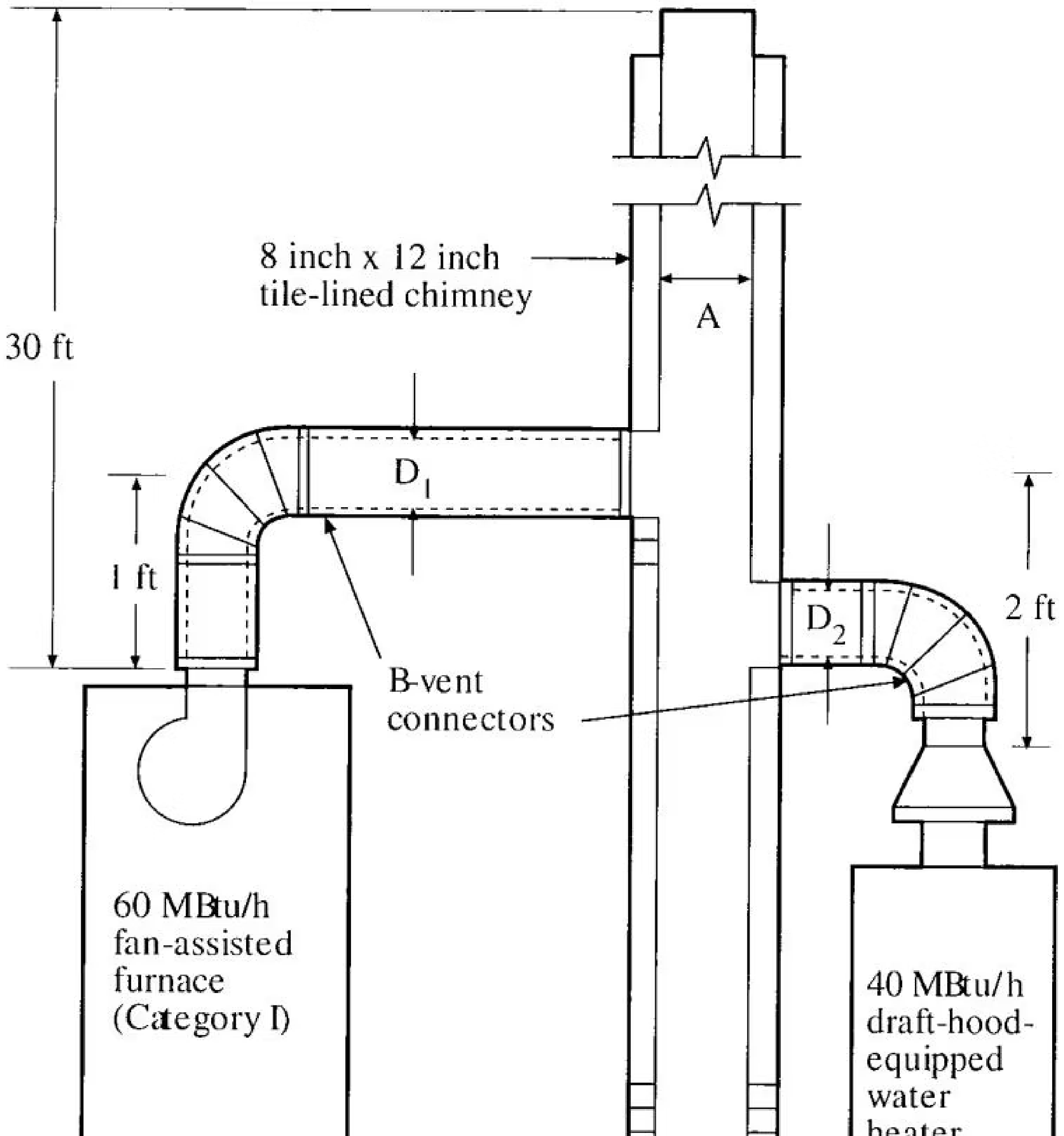
Example 7: Fan-Assisted and Draft-Hood-Equipped Appliances with Type B Vent Connectors to Common B-Vent

Figure 4-14
Example 7



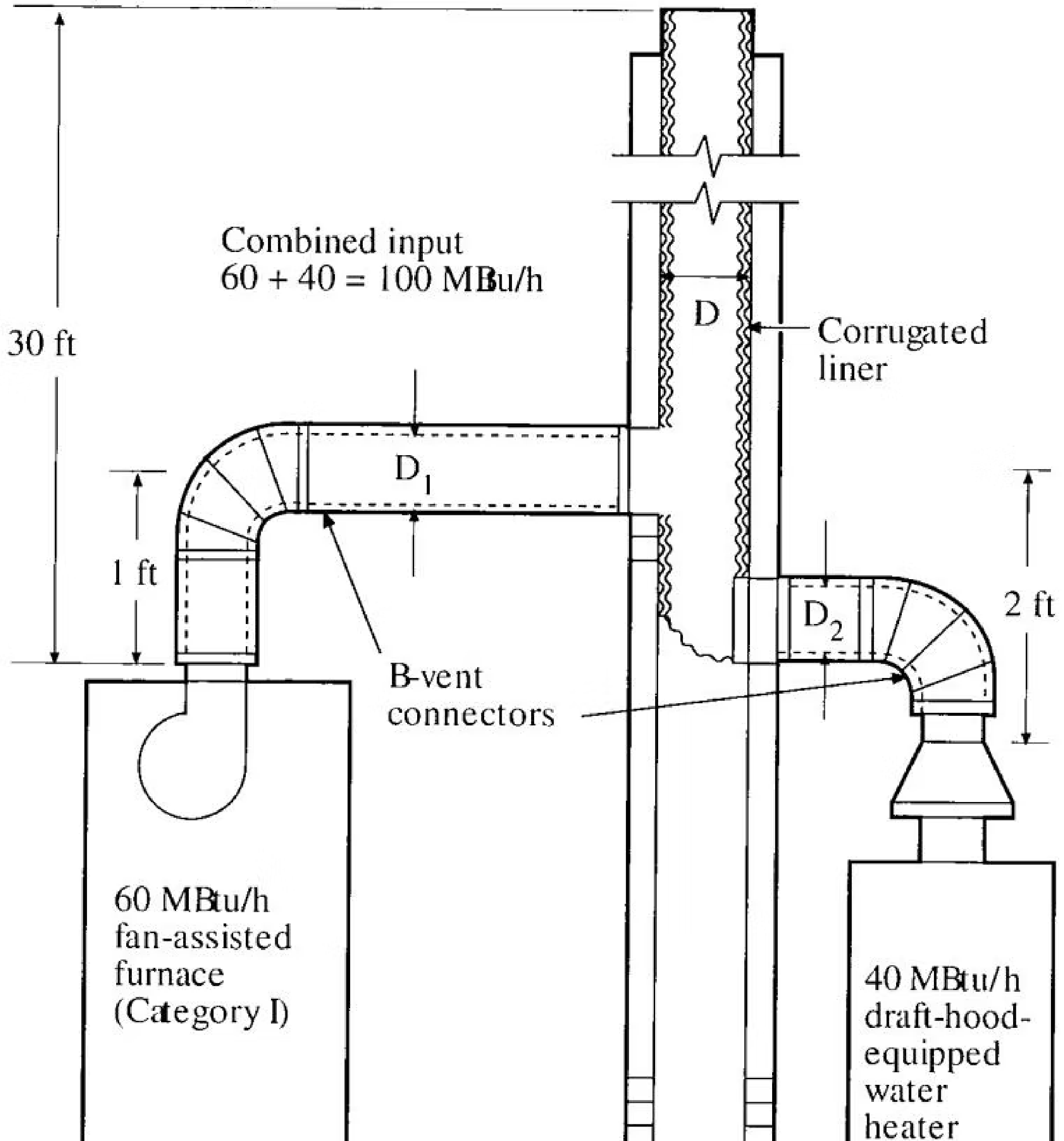
Example 8: Fan-Assisted and Draft-Hood-Equipped Appliances with Type B Vent Connectors to Tile-Lined Chimney

Figure 4-15
Example 8

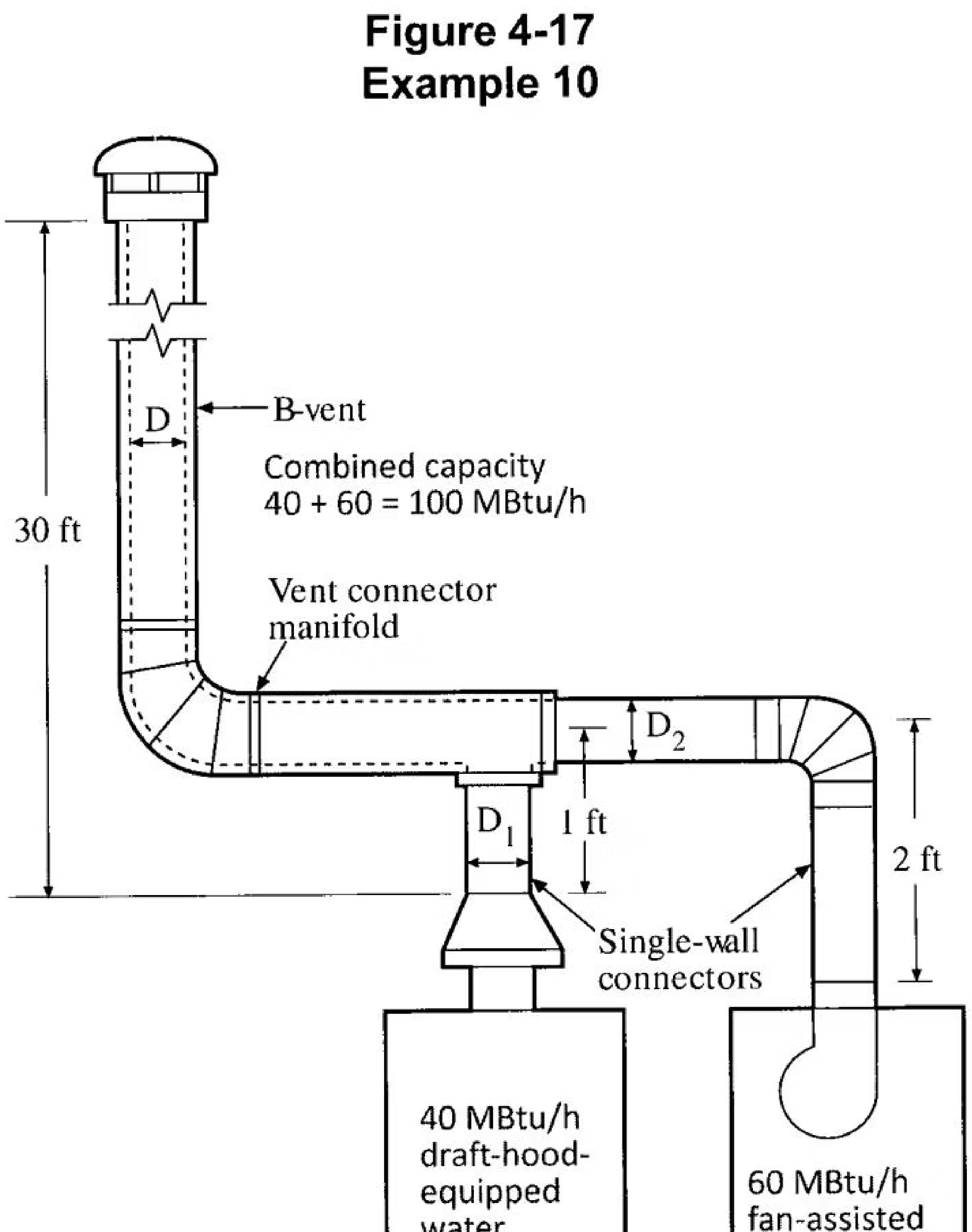


Example 9: Fan-Assisted and Draft-Hood-Equipped Appliances with Type B Vent Connectors to Certified Corrugated Liner

Figure 4-16
Example 9

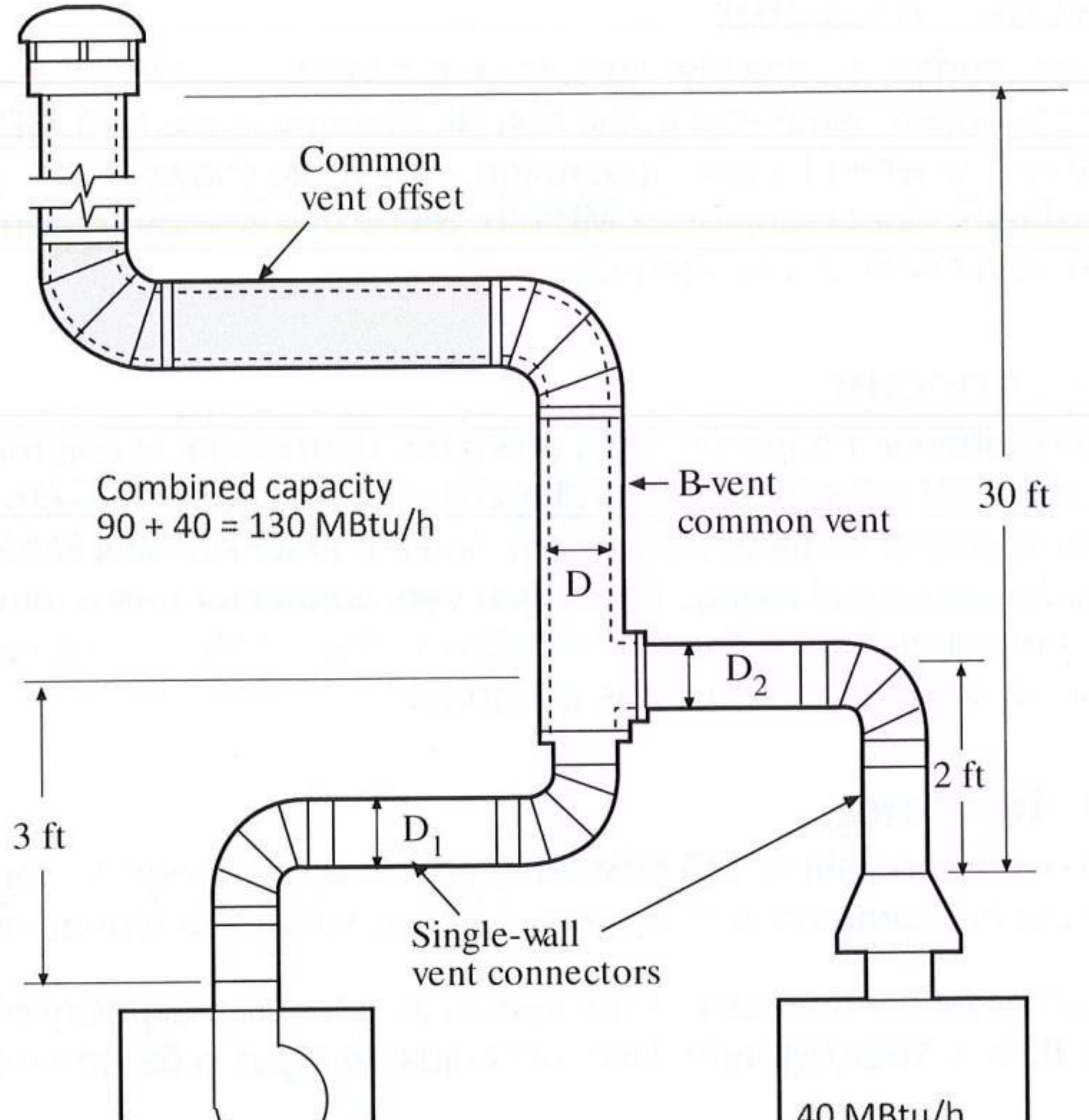


Example 10: Fan-Assisted and Draft-Hood-Equipped Appliances with Type B Vent Connector Manifold to Common Vent



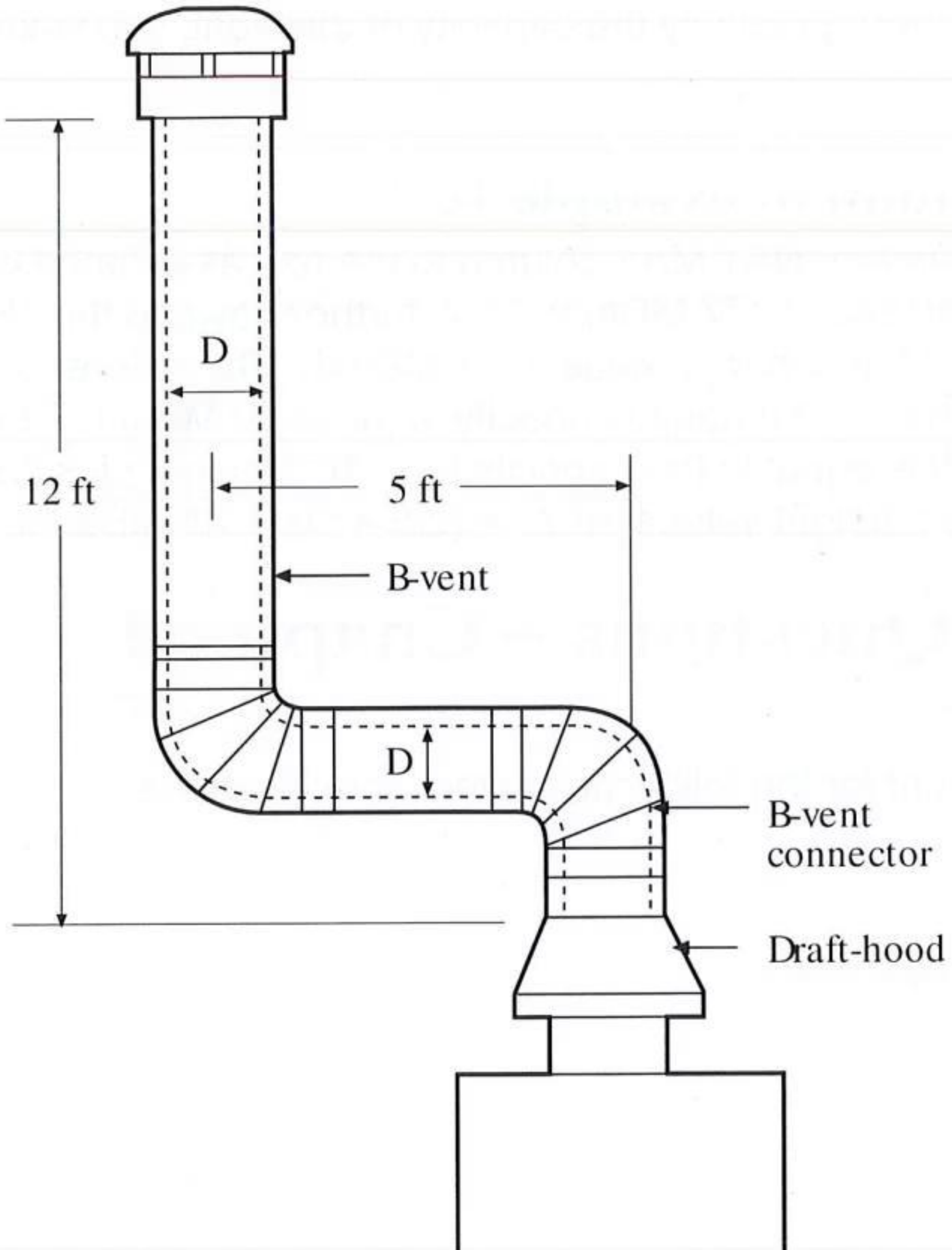
Example 11: Fan-Assisted and Draft-Hood-Equipped Appliances with Single-Wall Vent Connectors to Common B-Vent with Offset

Figure 4-18
Example 11



Example 12: Interpolating Between Table Values

Figure 4-19
Example 12



Types of Venting Systems

Fan-Assisted Appliance Systems

Fan-assisted appliance with single-wall vent connector to B-vent

Draft-Hood-Equipped Appliance Systems

Draft-hood-equipped appliance with single-wall vent connector to B-vent

Chimney Systems

Draft-hood-equipped appliance with single-wall vent connector to tile-lined chimney

Liner Systems

Draft-hood-equipped appliance with single-wall vent connector to certified corrugated liner

Multiple Appliance Venting Systems

Fan-Assisted Combinations

Two fan-assisted appliances with Type B vent connectors to common B-vent

Draft-Hood Combinations

Two draft-hood-equipped appliances with single-wall vent connectors to common B-vent

Mixed Appliance Combinations

Fan-assisted and draft-hood-equipped appliances with Type B vent connectors to common B-vent

Chimney Combinations

Fan-assisted and draft-hood-equipped appliances with Type B vent connectors to tile-lined chimney

Special Venting Configurations

Liner Configurations

Fan-assisted and draft-hood-equipped appliances with Type B vent connectors to certified corrugated liner

Manifold Configurations

Fan-assisted and draft-hood-equipped appliances with Type B vent connector manifold to common B-vent

Offset Configurations

Fan-assisted and draft-hood-equipped appliances with single-wall vent connectors to common B-vent with offset

Interpolation Applications

Interpolating between table values or using worst case scenario table values

Understanding Vent Capacity Tables

Table Structure

The vent sizing tables are organized by vent diameter, height, and lateral length. They provide capacity ratings in thousands of Btu/h for different types of appliances and venting configurations.

Column Types

FAN columns are used for fan-assisted appliances, while NAT columns are used for natural draft (draft-hood-equipped) appliances. The DP column accounts for house depressurization, while the MAX column is for leaky structures without air exhausting equipment.

Vent Connector Considerations

Type B Vent Connectors

Double-wall metal vent connectors that provide better insulation and higher capacity ratings than single-wall connectors. Use Tables C.1 and C.3 for sizing.

Single-Wall Vent Connectors

Less expensive but have lower capacity ratings and require greater clearance to combustibles. Use Tables C.2 and C.4 for sizing.

Connector Rise

The vertical distance from the appliance outlet to the horizontal run. Greater rise improves venting performance and increases capacity ratings.

Lateral Length

The horizontal distance from the vertical rise to the vertical vent. Longer laterals reduce capacity ratings and should be minimized when possible.

Common Vent Considerations

Vent Height

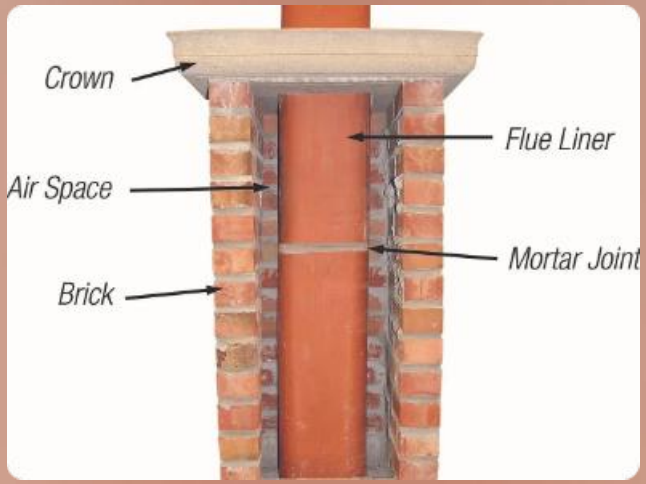
The vertical distance from the connector entrance to the vent termination. Greater height improves venting performance and increases capacity ratings.

Vent Diameter

The smallest acceptable diameter for vents and vent connectors is preferred to maintain proper velocity and minimize condensation.

Vent Offsets

Horizontal shifts in the vertical vent that reduce capacity by 20%. The length of the offset is limited to 1.5 ft for each inch of common vent diameter.



Chimney Considerations

Tile-Lined Masonry Chimneys

Existing chimneys must be lined, in good condition, and located on an interior wall to prevent excessive cooling. The liner must not be oversized to prevent condensation.

Chimney Liner Sizing

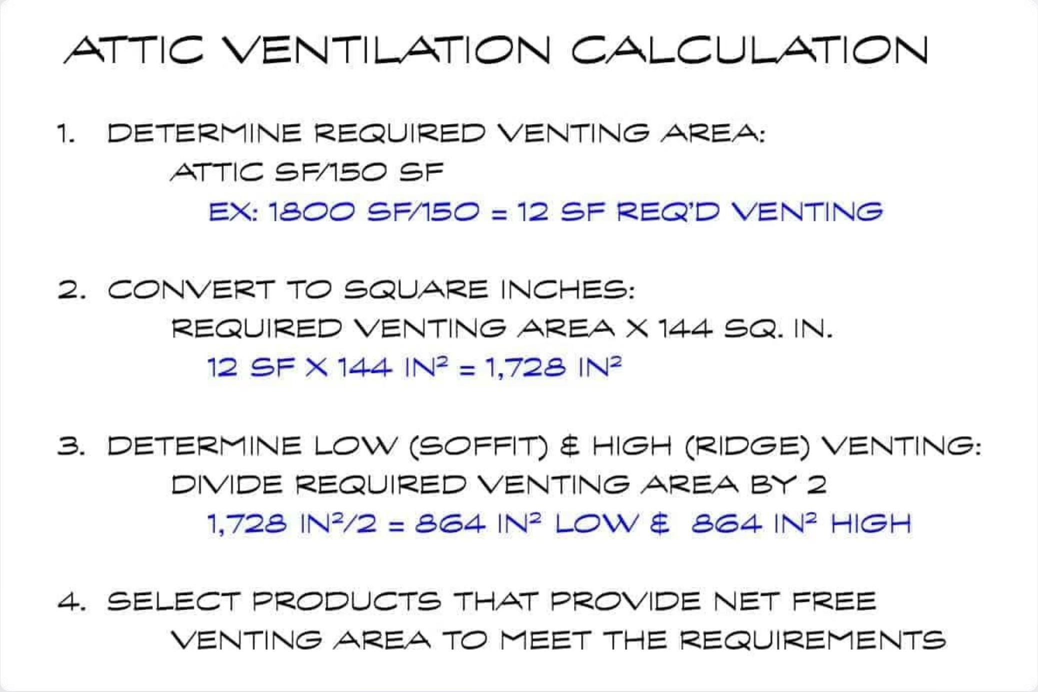
The liner must have an internal area within the minimum and maximum limits specified in the tables. The listed capacity must not exceed the appliance input rating by more than 25%.

Corrugated Liners

Certified corrugated liners require a 20% reduction in capacity compared to smooth-walled liners. Adjust the appliance input by dividing by 80% to determine the correct liner size.

Capacity Adjustment Factors

Condition	Adjustment Factor	Application
3 Elbows in Vent Connector	Reduce by 10%	Apply to vent connector capacity
Horizontal Common Vent Connector Manifold	Reduce by 10%	Apply to common vent capacity
Common Vent Offset	Reduce by 20%	Apply to common vent capacity
Certified Corrugated Liner	Reduce by 20%	Apply to liner capacity



ATTIC VENTILATION CALCULATION

1. DETERMINE REQUIRED VENTING AREA:
   ATTIC SF/150 SF
   EX: 1800 SF/150 = 12 SF REQ'D VENTING
2. CONVERT TO SQUARE INCHES:
   REQUIRED VENTING AREA X 144 SQ. IN.
   12 SF X 144 IN^2 = 1,728 IN^2
3. DETERMINE LOW (SOFFIT) & HIGH (RIDGE) VENTING:
   DIVIDE REQUIRED VENTING AREA BY 2
   1,728 IN^2/2 = 864 IN^2 LOW & 864 IN^2 HIGH
4. SELECT PRODUCTS THAT PROVIDE NET FREE
   VENTING AREA TO MEET THE REQUIREMENTS

House Depressurization Considerations

The 0.02 inch w.c. (5 Pa) depressurization represents the threshold beyond which the spillage of fan-assisted and natural draft appliances will occur. This is a critical safety consideration in vent sizing.

Tight Buildings

Modern, well-sealed buildings are more susceptible to depressurization from exhaust fans, clothes dryers, and other air-exhausting equipment. Always use the DP column for these installations.

Loose Buildings

Older or less well-sealed buildings without air exhausting equipment may use the MAX column for natural draft appliances. This applies to structures like sheds or detached garages.

Vent Sizing Best Practices

1 Determine Appliance Type

Identify whether the appliance is fan-assisted or draft-hood-equipped (natural draft) to use the correct table columns.

2 Measure System Dimensions

Accurately measure the vent height, connector rise, and lateral length to find the correct row in the tables.

3 Assess Building Conditions

Evaluate whether the building is tight or loose and whether it contains air exhausting equipment to determine whether to use the DP or MAX column.

4 Apply Adjustment Factors

Account for elbows, manifolds, offsets, and corrugated liners by applying the appropriate capacity reduction factors.

Vent Sizing Procedure Summary

Gather Information

Collect appliance input ratings, vent heights, connector rises, and lateral lengths

Select Appropriate Table

Choose the correct table based on connector type and appliance configuration

Find Capacity Values

Locate the appropriate capacity values in the table based on system dimensions

Apply Adjustments

Adjust capacity values for elbows, manifolds, offsets, or corrugated liners

5

Verify Sizing

Ensure the selected vent size has adequate capacity for the appliance input

Common Venting Errors to Avoid

Undersized Vents

Using a vent with insufficient capacity can lead to poor draft, spillage of flue gases, and potential carbon monoxide hazards.

Oversized Vents

Using a vent that is too large can cause excessive cooling of flue gases, leading to condensation, corrosion, and deterioration of the vent system.

Ignoring Adjustment Factors

Failing to account for elbows, manifolds, offsets, or corrugated liners can result in inadequate venting capacity.

Using Wrong Table Columns

Using the MAX column instead of the DP column in a tight building with air exhausting equipment can lead to venting problems.

Venting System Safety Considerations

Carbon Monoxide Hazards

Improper venting can lead to carbon monoxide production and spillage into the living space, creating a serious health hazard.

Condensation Issues

Excessive condensation in vents can lead to corrosion, deterioration, and eventual failure of the venting system.

Backdrafting

House depressurization can cause backdrafting, where flue gases are pulled back into the building instead of being exhausted outdoors.

Safety Devices

Carbon monoxide detectors and spillage switches provide additional safety but do not replace proper vent sizing and installation.

Consulting with Authorities

In many cases, it's important to consult with local authorities to ensure compliance with regional requirements and best practices.

Local Inspection Authority

Consult when the tables do not show a particular venting system arrangement or when alternative venting methods are being considered.

Propane Distributor or Gas Utility

Seek guidance on specific venting requirements and recommendations for your region and application.

Manufacturer's Instructions

Always follow the manufacturer's certified installation instructions for specific appliance venting requirements.

Authority Having Jurisdiction

The final decision on venting system approval rests with the local authority having jurisdiction.

Venting System Inspection and Maintenance

Visual Inspection

Regularly inspect vents and chimneys for signs of deterioration, blockages, or improper connections.

Leak Testing

Check for leaks in the venting system that could allow flue gases to escape into the building.

Cleaning

Remove any debris, nests, or buildup that could restrict the flow of flue gases.

Component Replacement

Replace any damaged or deteriorated components to maintain the integrity of the venting system.

Venting System Documentation

Installation Records

Document the vent sizing calculations, including appliance inputs, system dimensions, and table values used.

Record any adjustments made for elbows, manifolds, offsets, or corrugated liners.

Inspection Reports

Maintain records of all inspections, including the condition of the venting system and any issues identified.

Document any repairs or modifications made to the venting system.

Venting System Troubleshooting

Problem	Possible Causes	Solutions
Spillage of Flue Gases	Undersized vent, excessive house depressurization	Resize vent, reduce depressurization, add makeup air
Condensation in Vent	Oversized vent, low flue gas temperature	Resize vent, insulate vent, increase appliance firing rate
Poor Draft	Insufficient vent height, excessive lateral length	Increase vent height, reduce lateral length, resize vent
Vent Corrosion	Condensation, improper materials	Use corrosion-resistant materials, resize vent, address condensation

Venting System Upgrades

Replacing Older Appliances

When replacing older appliances with newer, more efficient models, the existing venting system may need to be modified or replaced to accommodate the different venting characteristics.

Fan-assisted appliances typically produce lower volume and temperature flue gases, requiring careful sizing to prevent condensation.

Upgrading Venting Materials

Replacing single-wall vent connectors with Type B connectors can improve venting performance and reduce clearance requirements.

Installing certified liners in masonry chimneys can address oversizing issues and improve venting efficiency.

Future Trends in Venting Systems

Higher Efficiency Appliances

As appliance efficiency increases, flue gas temperatures decrease, requiring more careful vent sizing and potentially different venting materials.

Tighter Building Envelopes

Modern construction techniques create tighter buildings, increasing the importance of proper vent sizing and consideration of house depressurization.

Advanced Venting Technologies

New venting materials and systems are being developed to address the challenges of venting high-efficiency appliances in tight buildings.

Environmental Considerations

Increasing focus on reducing emissions and improving indoor air quality will drive changes in venting system design and requirements.

Summary: Key Points for Vent Sizing

Identify Parameters

Determine appliance type, input rating, vent height, connector rise, and lateral length

Understand Tables

Know how to interpret and apply the vent sizing tables in CSA B149.1

Apply Adjustments

Account for elbows, manifolds, offsets, and corrugated liners

Verify Sizing

Ensure the selected vent size has adequate capacity for the appliance input

Prioritize Safety

Consider house depressurization and potential condensation issues

CSA Unit 22

Chapter 5
Vent Inspection

For the gas technician/fitter to deliver a safe, quality appliance venting system, there must be communication between the gas technician/fitter (as installer) and inspectors. It is the responsibility of the gas technician/fitter to ensure that the venting system works through inspection of the venting before and during operation.

Purpose and Objectives

Purpose

For the gas technician/fitter to deliver a safe, quality appliance venting system, there must be communication between the gas technician/fitter (as installer) and inspectors. It is the responsibility of the gas technician/fitter to ensure that the venting system works through inspection of the venting before and during operation.

Objectives

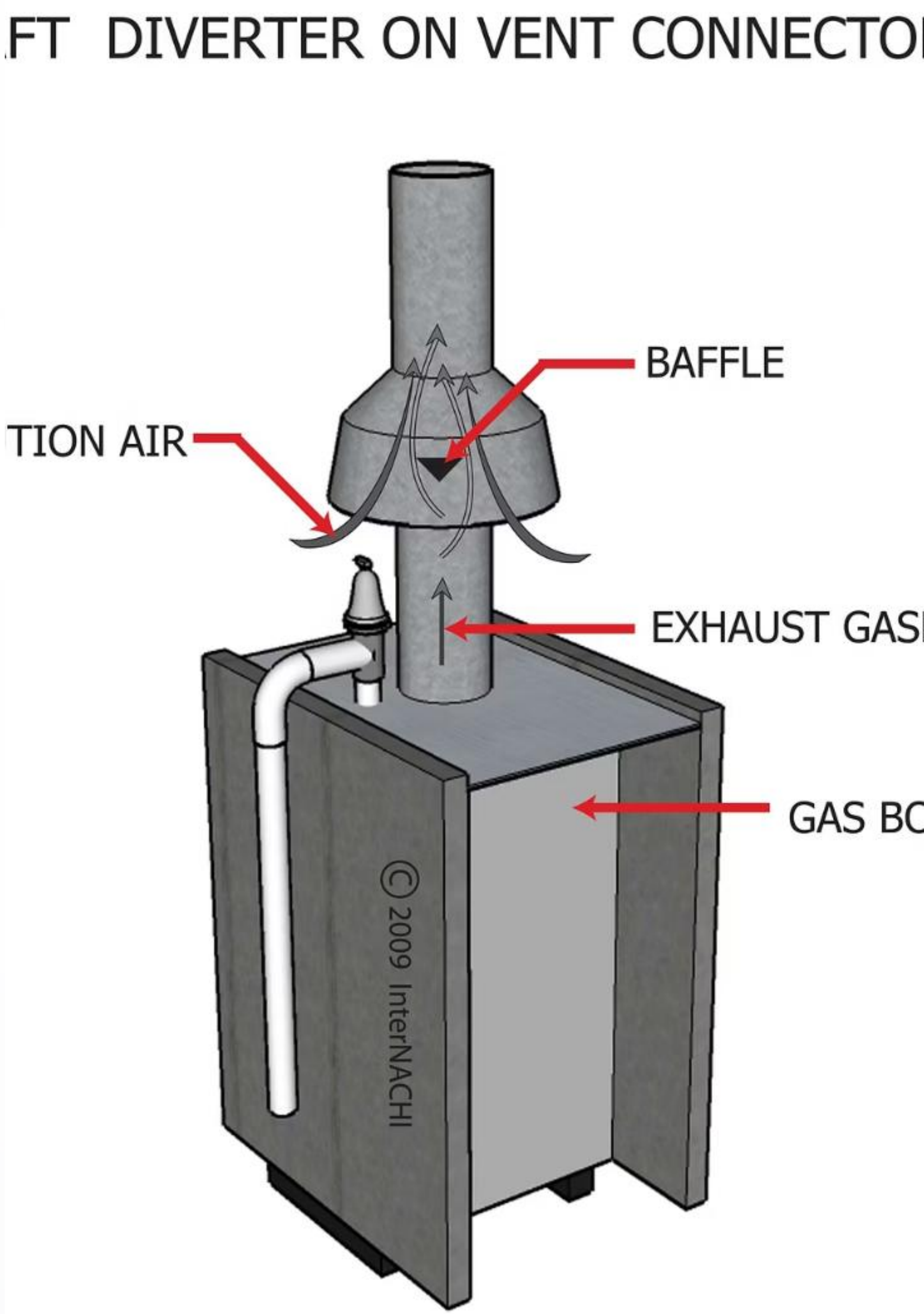
At the end of this chapter, you will be able to:

- describe venting system problems
- check operation of the venting system

Key Terminology

Draft Hood Spillage

The escape of flue gases from the relief opening of the draft hood of a natural draft appliance



Introduction to Vent Inspection

Collaboration

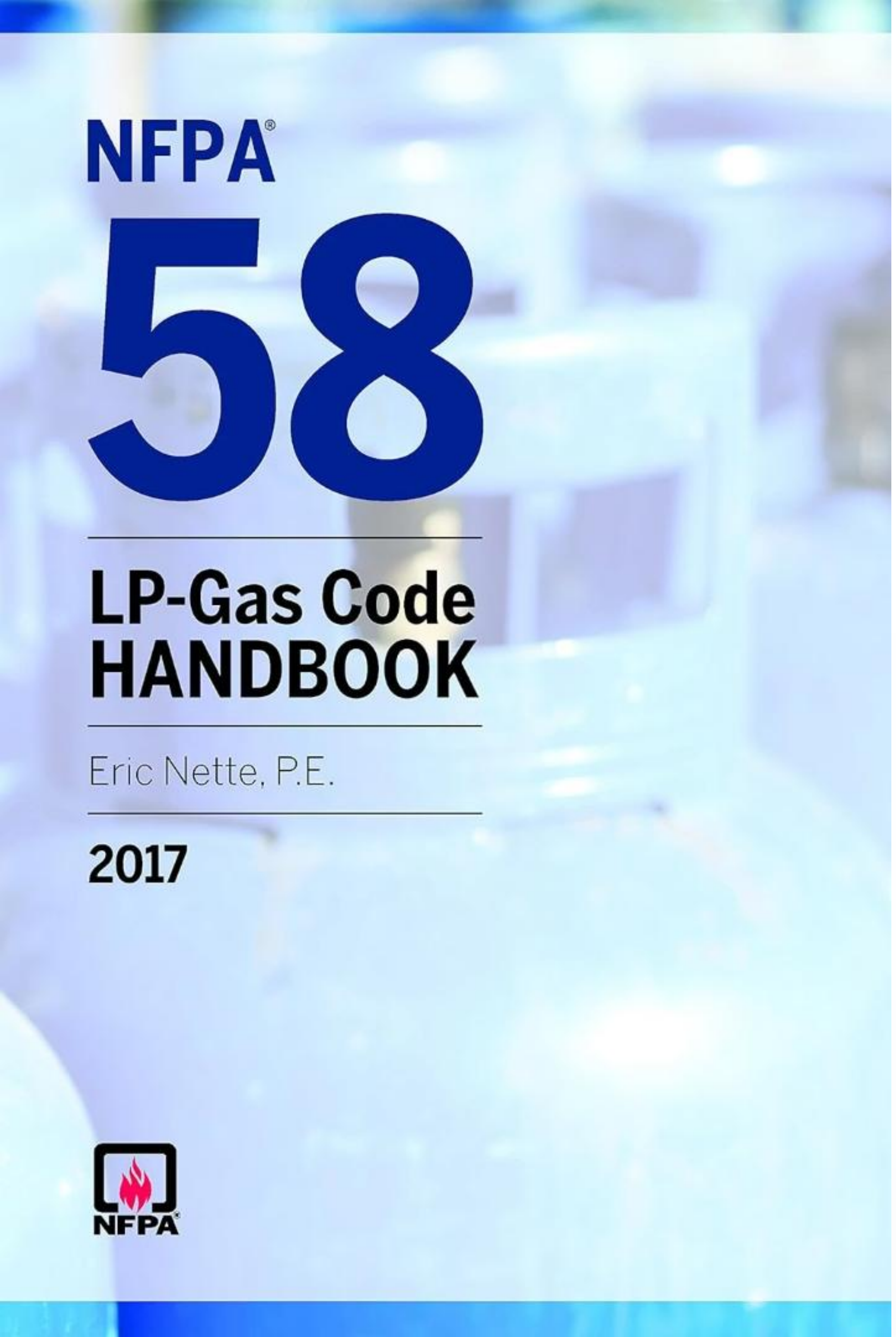
For the gas technician/fitter to deliver a safe, quality appliance venting system, there must be collaboration between the gas technician/fitter and other trades, and between installers and inspectors.

Quality Assurance

Installation and inspection are parts of a single system, with the inspection process serving as an independent quality assurance check on the final installed appliance.

Inspection Systems

Systems of inspection vary widely among jurisdictions, but it is important to have inspections performed promptly and completely.



Code Requirements Review

Many of the items in the checklists for appliance installation that are discussed in Chapter 3. Vent design and installation requirements for Category 1 appliances apply equally to the inspection process. After an installation is complete, the gas technician/fitter must ensure that the following checks are made prior to the inspection.

Pre-Inspection Checklist

Schedule Inspections

Inspections should be arranged in advance to avoid delays after you have finalized the installation.

Test Flashing

Test the flashing where the vent has penetrated the roof with a water hose and look for leaks.

Check Appearance

The appearance of the installation should be neat and orderly to an established standard of workmanship.

Verify Support System

A support system suitable for the weight and design of the material employed must support the exhaust vent pipe and fittings securely. The appliances are not designed to support the weight of the vent.

Additional Pre-Inspection Items

Plastic Venting

Plastic venting must be free to expand and contract.

Fire Penetration

For commercial installations, check for approved and properly installed fire penetration assemblies.

Protective Screens

Are protective screens or covers in place for sidewall vents?

Two Pipe Systems

Two pipe systems are properly terminated with a cap and or bird screen.

Type BH Vent Systems

Slope Requirements

Are Type BH vent systems adequately sloped by to the appliance condensate trap or have additional condensate drains been installed and piped to drain?

Leak Testing

Ensure there is no flue gas leakage on non-co-axial Type BH vents. Use a soapy solution to check for leaks with the gas supply turned off and the exhaust fan running.

Condensate Requirements

Does the local authority require that flue gas condensate be run through an acid neutralizer before entering the drainage system?

Final Installation Steps

Prime Condensate Traps

Condensate traps should be primed at initial start-up.

Verify Appliance Operation

Ensure all appliances are running in the house.

Provide Owner Instructions

The building owner or occupant should be instructed in the safe and proper use of the appliances and should be provided with all relevant instructions, warranties, etc.

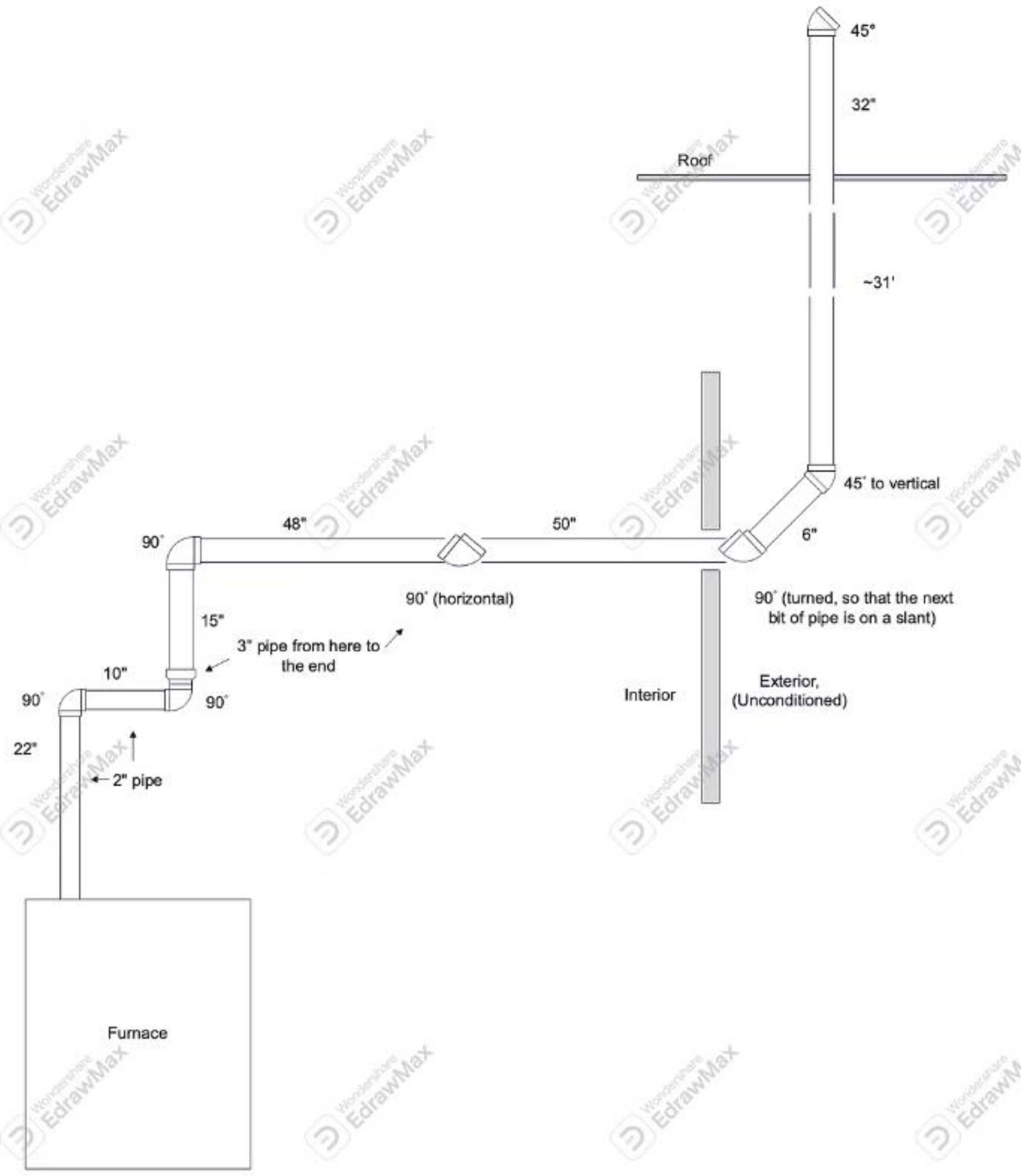
Venting System Problems Overview

Current Building Code requirements for the control of building pressures and combustion appliance spillage make gas appliance venting and spillage susceptibility important factors for consideration. Venting system problems are the most common problem in the gas industry. To avoid venting problems in the field, the gas technician/fitter should be aware of the most common causes and how to check for them.

Flue Gas Spillage

Condensation

Corrosion



Flue Gas Spillage

The spillage of combustion products can occur when a spillage-susceptible appliance is subjected to a sustained negative pressure greater than the buoyancy venting pressure it can establish during its operation.

Flue gas spillage is the most serious venting problem, particularly if it is prolonged. The recirculation of flue gases through the burner of an appliance creates carbon monoxide, a colourless, odourless and deadly gas. Even if carbon monoxide is not developed, many people experience irritation and discomfort from flue gases that spill into the occupied space of a building.

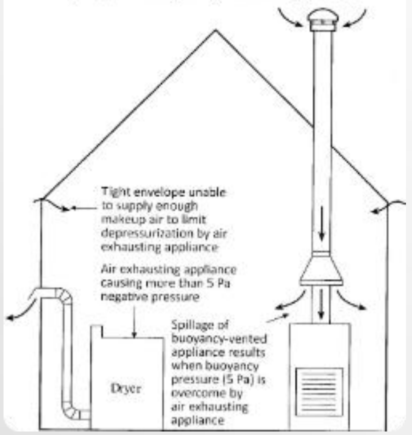


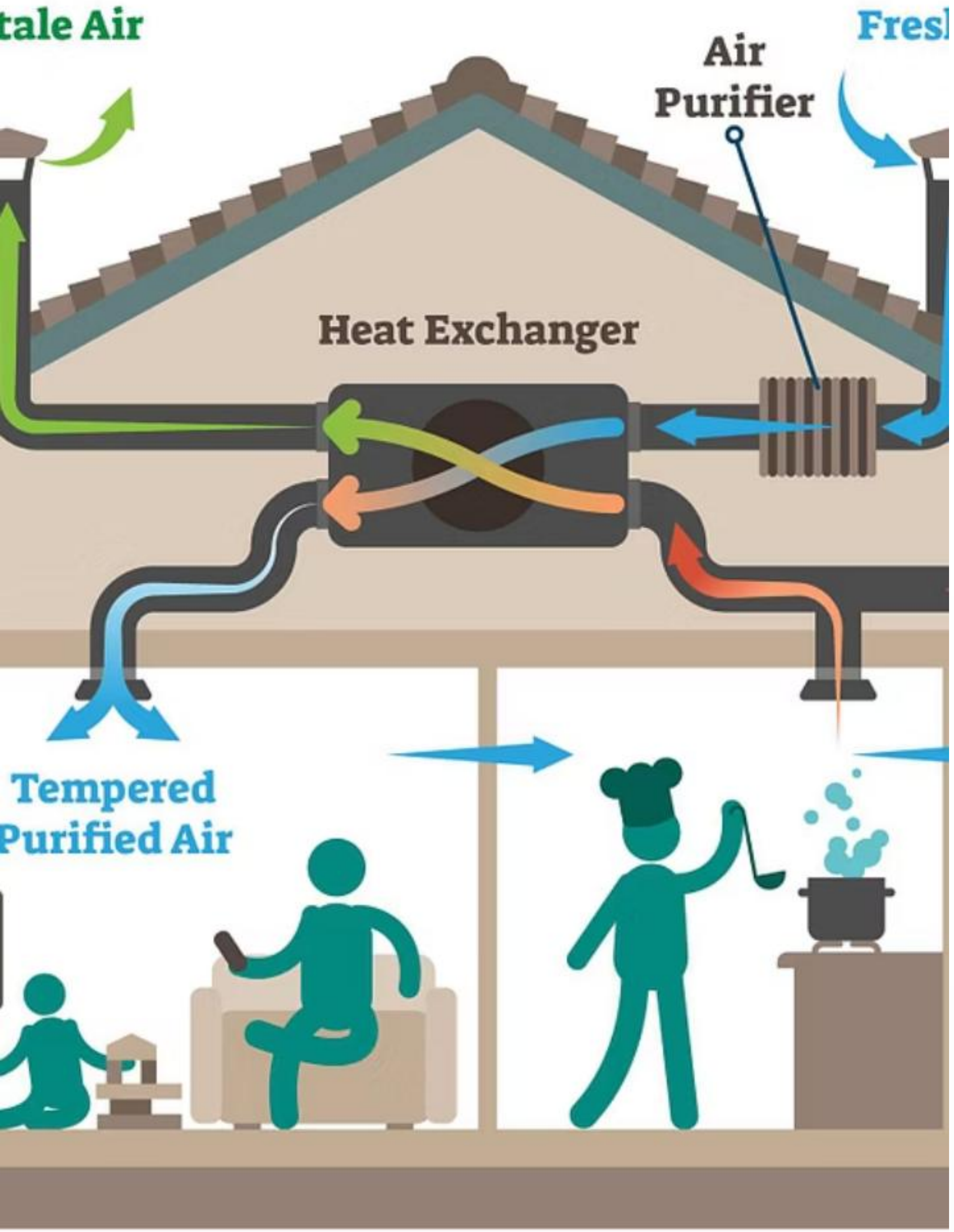
Figure 5-1
Spillage of buoyancy-vented appliance

Common Causes of Spillage

The most common cause of spillage is a failure to control negative air pressures in a building where buoyancy-vented appliances are installed. This is considered to be the lack of makeup air.

Additional Causes of Spillage

Cause	Description
Blocked or restricted venting system	Birds' nests, debris, and incorrectly sized vent caps (rain caps) have been known to cause spillage. Blockage by nests, insect infestations, and accumulated debris can plug the venting system completely. To avoid this, install vent caps with screens and inspect the venting system seasonally.
Incorrectly sized venting system	Spillage can occur when a venting system is too small, uses an excessive number of elbows, or includes long lateral runs.
Leaks in venting system	Improperly joined and sealed components of the venting system can lead to leakage of flue gases into the building. Observing proper fitting practices is a must.



Improper Vent Configuration

Common Vent Issues

This problem is common when fan-assisted and draft-hood-equipped appliances are connected to a common vent. In such cases, configure the vent connectors so that the draft-hood-equipped appliance vent connector enters the common vent above the fan-assisted vent connector.

Avoiding Flue Gas Diversion

Avoid configurations where it is obvious that flue gases will be diverted into the building rather than up the common vent.

Spillage Susceptibility

Spillage susceptibility involves both the venting characteristics of the appliance and the method of venting.

Spillage-Susceptible Appliances

Appliances are considered spillage-susceptible in either situation:

- buoyancy drives venting
- venting system is not gas-tight

Non-Spillage-Susceptible Appliances

Non-spillage-susceptible appliances are power vented to a gas-tight venting system, making them resistant to spillage at relatively high negative building pressures.

Pressure Threshold for Spillage

The currently established threshold of negative pressure that an appliance must withstand to be considered non-spillage susceptible is -0.02 inch w.c. (-5 Pa). This is based on the typical buoyancy venting pressure developed by natural draft and fan-assisted appliances.

Category I and II Appliances

Based on this threshold, natural draft and fan-assisted appliances of the Category I type are considered spillage susceptible, as are Category II appliances. Type B, BW, and L vents that are not gas-tight are also considered spillage susceptible.

Category III and IV Appliances

Induced or forced-draft gas appliances (Categories III and IV) are not considered spillage susceptible when connected to a gas-tight venting system (e.g., a type BH venting system with sealed joints).

Direct Vent Appliances

Direct vent appliances (in any Category, I through IV), due to their sealed method of air supply and venting, are also considered non-spillage susceptible.

Practical Installation Guidelines

Avoid Installing

- Category I natural-draft or fan-assisted gas appliances in buildings that experience greater than -0.02 inch w.c. (-5 Pa) pressure
- appliances connected to Type B, BW, or L venting systems in buildings exceeding the 0.02 inch w.c. (5 Pa) negative pressure threshold

Consider These Factors

- Does or will the building contain air exhausting appliances without the provision of makeup air?
- Is the building of recent construction, and does it appear to have a tight building envelope?
- Does the structure or enclosure comply with Clause 8.2.1 a) or b) of CSA B149.1?

Condensation in Venting Systems

In a properly designed and installed venting system, the amount of condensation forming in the vent is negligible, and as the vent or chimney warms up during appliance operation, this evaporates and travels to the outdoors.

Avoid excessive condensation in the venting system. Prolonged periods of condensation can lead to puddles of water in the building and to moisture damage within the fabric of the building if condensate leaks through joints in the concealed sections of the venting system.

Corrosion of metal vents may also occur as a result of prolonged condensation.

Causes of Condensation: Cold Vents

Cold Vents or Chimneys

All Category I appliance vents and chimneys must be warm to perform properly

Exterior Placement Issues

Avoid exterior vents and chimneys unless these are properly insulated

Winter Performance

Cold vents and chimneys that are not properly insulated will cause condensation throughout the entire operating time during colder periods

Causes of Condensation: Oversized Systems

Surface Area Problems

An oversized venting system can lead to condensation problems because the internal surface area of the vent is too large to warm above the dew point of the flue gases (127 - 130°F).

Fan-Assisted Appliances

This is particularly the case when fan-assisted appliances are involved. A fan-assisted appliance is of higher efficiency than draft-hood-equipped appliances; hence, it has a lower flue gas temperature. There is also no dilution air entering the venting system during the operation of fan-assisted appliances.

Proper Sizing

Always size venting systems serving fan-assisted appliances using the minimum allowable vent diameters.

Corrosion in Venting Systems

Causes of Corrosion

In the venting system, corrosion is most often a secondary effect of condensation. It may be as a result of the reaction caused when a chlorinated hydrocarbon is heated in air. In the presence of a very slight trace of water, it will form hydrochloric acid, which has a highly corrosive effect on most metals.

Prevention Measures

Corrosion in a venting system can be a result of either the flue products condensing in the vent system or an outside source of corrosive vapours. To avoid corrosion problems due to condensation, you may use only venting systems designed for condensing appliances on condensing appliances. Conventional venting systems require flue temperatures above the point at which the flue products will start to condense.

Other Venting System Problems

Leaking

Joints that aren't properly sealed can allow flue gases to escape

Wind Effect

Cold and hot backdraft caused by wind conditions

Sagging

Improper support can cause sections to sag and collect condensate

Incorrect Grade

Horizontal runs must have proper upward slope

Poor Location

Terminations in areas affected by wind or pressure zones

Checking Venting System Operation

Fan-assisted and draft hood combustion appliances, when used alone or in combination, can cause a variety of problems in the operation of the venting system. This is, in part, because of many variables in both appliance operation and the location and environment surrounding the appliance venting systems.

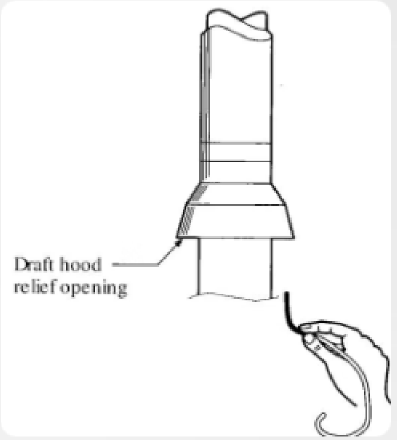
Detecting Spillage

Draft hood spillage is the escape of flue gases from the relief opening of the draft hood of a natural draft appliance. On start-up, a little spillage of short duration is normal, but if it does not stop after a minute or two, there may be something wrong in the venting system.

Detection Methods

- Introducing smoke into the flue products ahead of the draft hood
- Observing if the flame of a match goes out when it is held at the edge of the draft hood relief opening

Figure 5-2
The smoke taper test for draft hood spillage



Smoke Taper Test Procedure

Complete Connections

After all gas piping, electrical, and vent connections are in place, proceed with testing

Adjust and Light

Adjust the appliance and light the main burner, allowing several minutes for warm-up

Hold Taper

Hold a lighted taper just under the rim of the draft hood relief opening

Observe Smoke Flow

Proper venting will draw the taper smoke towards or into the draft hood. The escape or spillage of burned gas through improper venting will cause the smoke to blow away from the relief opening

Problems in the Vent

Where there is continued draft hood spillage due to problems in the vent itself, the installer should check for one or several of the following possible causes:

Size Issues

Inadequate connector size in a combined venting system

Rise Problems

Insufficient connector rise in a combined venting system

Blockage

Blockage in the system, which may be partial or total

Length Issues

An excessively long connector (especially if it is single-wall)

Additional Vent Problems

Directional Changes

Too many fittings that change direction cause excessive flow resistance

Height Issues

Vent not high enough

Cap Problems

Incorrect cap causes flow restriction

Pressure Issues

Building depressurization and pressure from thermal effects

Troubleshooting Vent Problems

Determining the Cause

Once you determine the cause as one of the above, you can find the remedy by checking the vent against the Code tables if it is otherwise unobstructed.

Low Resistance Caps

In some instances, it has been found that using a listed vent cap of low resistance will solve the problem.

Appliance Fails to Operate

There are many possible reasons why an appliance fails to operate, some of which may be related to the venting system. Others may be due to burner ignition or other control difficulties.

Venting-Related Issues

- An undersized or otherwise improperly designed venting system may cause a venting safety control to prevent burner ignition or shut it down if draft hood spillage occurs
- With a fan-assisted combustion appliance, under Category I conditions, positive pressure in the vent or inadequate vent flow may prevent or interrupt burner operation

Safety Controls

With a draft hood appliance equipped with a blocked vent detection device (also called a spill switch), the burner may shut off if spillage continues for a period of time, or the burner may operate intermittently for short periods. Its duration of operation may depend on how long it takes for the spillage detection control to be activated.

Troubleshooting Approach

If	Then
The vent is causing this problem.	Check the size and configuration against the tables. Check also for blockage, an improper vent cap, or building depressurization.
The venting system is correct, and there are no adverse indoor pressure conditions.	Finding the cause depends on a careful analysis of the manufacturer's instructions for appliance installation, operation, and troubleshooting.

Cold Backdraft

Normal Condition

A draft hood appliance not operating and cold air coming out of the relief opening is not a venting malfunction. For this to occur, there must be an indoor-outdoor temperature difference that causes cold air to be drawn down the vent, such as might occur if the vertical vent piping is entirely outdoors.

Other Causes

This flow reversal can also result from fan or fireplace operation.

Wind Effects

Winds can cause a cold backdraft. A wind blowing against the wall can easily reverse a vent terminating improperly next to an outside wall or below the eaves. Cold air enters the vent and exits through the draft hood because the vent acts just like a hole in the wall or an open window.

Hot Backdraft

Cold Backdraft First

A hot backdraft can occur if a cold backdraft has reversed flow in the vent and the appliance burner comes on

Appears as Spillage

With cold air entering the top and flowing downward in the vent, this appears to be draft hood spillage

Total Spillage

This causes total spillage of hot flue products because the vent does not carry away any flue products

Wind Factors

If indoor mechanical equipment causes the cold backdraft, the vent may never prime. But where there is an unsteady wind, a drop in wind velocity may allow the vent to get started correctly

Combined System Hot Backdraft

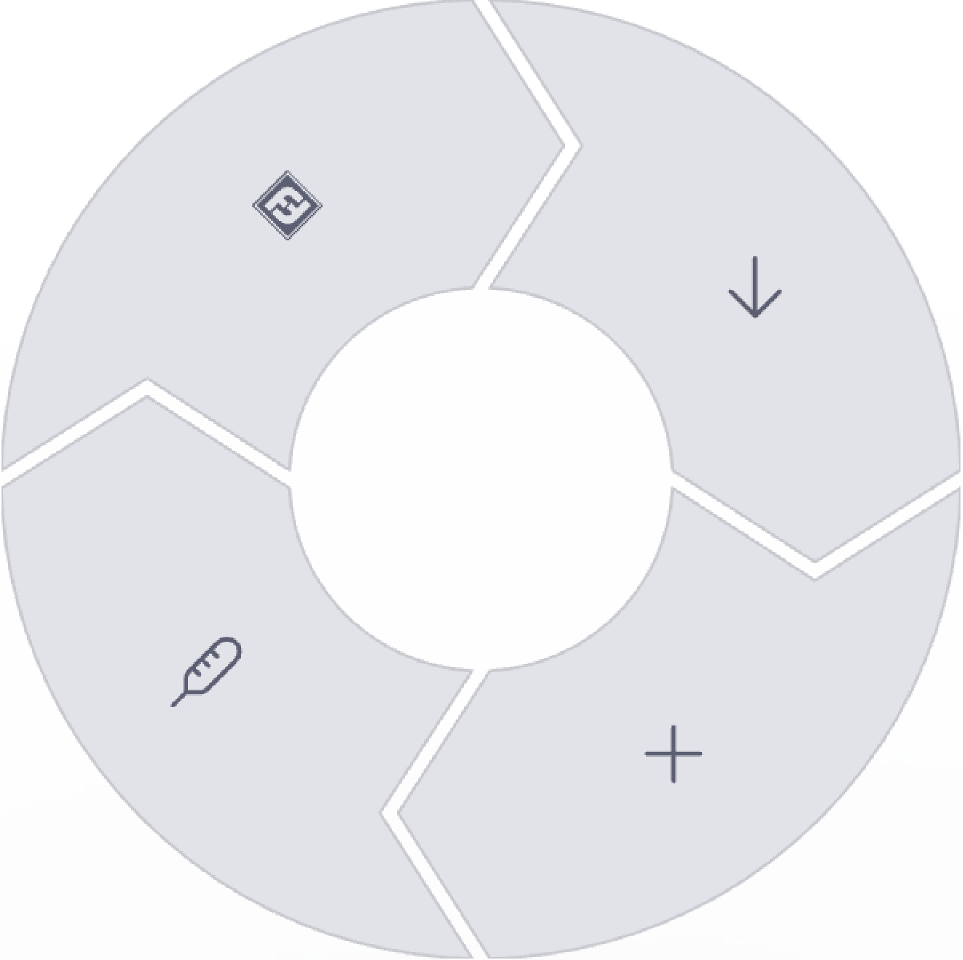
A hot backdraft can also occur in a venting system combining a fan-assisted appliance with a NAT (Natural Draft) appliance. If the common vent has insufficient capacity for the fan-assisted appliance, or if it becomes blocked, some or all the products of combustion from the fan-assisted appliance will be flowing out to the NAT appliance's draft hood.

If the NAT appliance operates under these conditions, it will experience total spillage as well. If this occurs, shut off both appliances until the situation is corrected.

Leakage at Joints

Fan Pressure

The vent pressure capability of fan-assisted appliances varies widely, but regardless, a fan can produce more pressure in a vent than gravity flow



Draft Hood Requirements

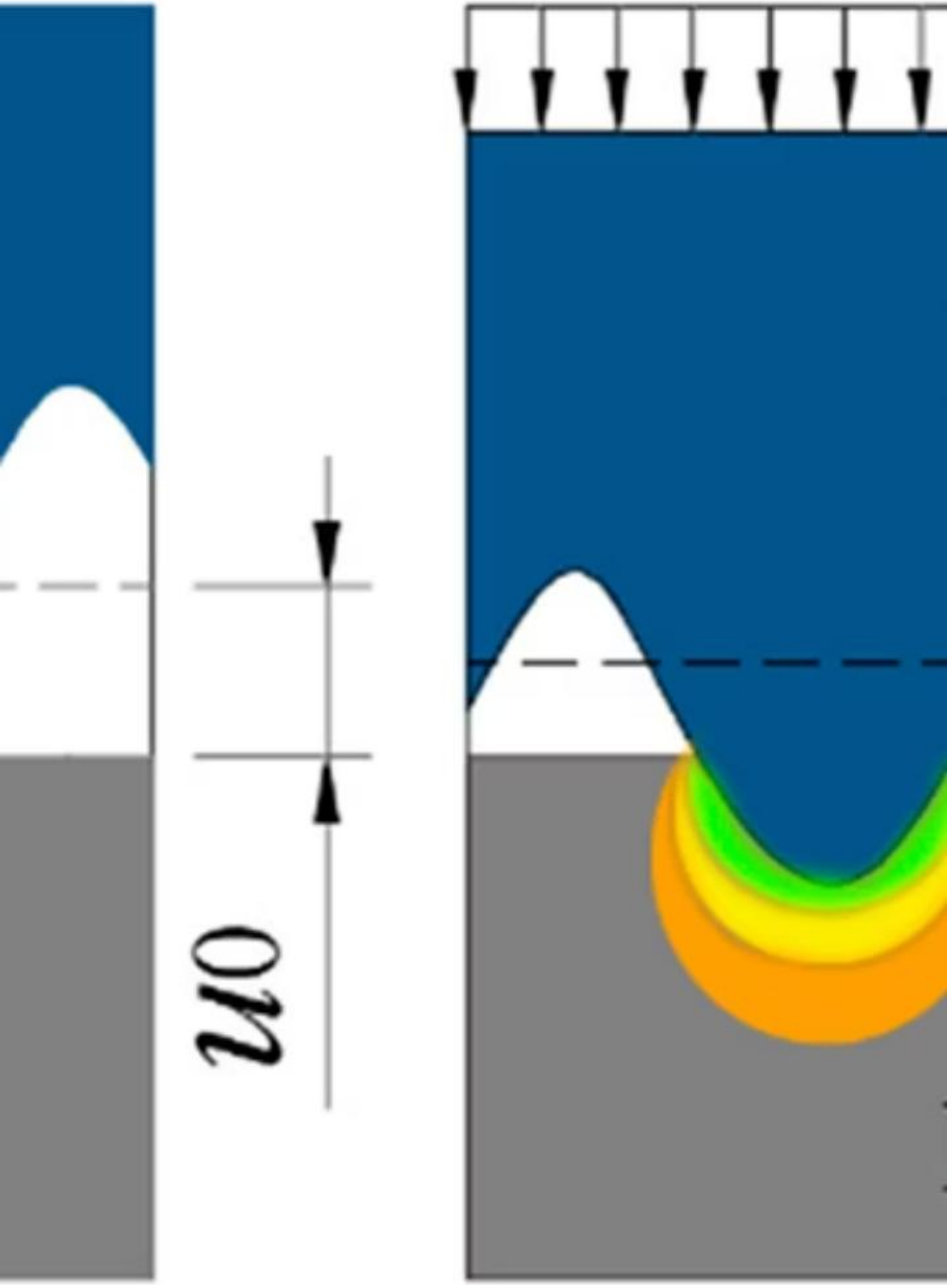
Draft hood appliances must have negative or below atmospheric pressure at the draft hood to draw in dilution air and prevent spillage

Category Differences

Only Category I and Category III appliances have high enough vent temperatures to obtain gravity flow

Positive Pressure

A fan-assisted appliance can produce both positive pressure and adequate vent flow at the same time



Causes of Joint Leakage

Leakage of products of combustion can occur at piping and fitting joints or between elbow segments if there is positive vent pressure. This could be due to:

Control Malfunction

Control malfunction on the appliance

Undersized Vent

An undersized vent

Incorrect Vent Type

Any use of Type B gas vent on an appliance that creates positive pressure

Remedies for Joint Leakage

Correct Solution

The remedy to positive pressure causing joint leakage problems with either a Category I or III appliance is to use a larger or higher vent with increased capacity or to reduce its flow resistance.

Incorrect Solution

B-vents should not be used with Category III appliances.

The incorrect remedy and one that violates the Type B product listing is to tape the joints externally.

Coaxial Venting Leak Test

Identify the Problem

Continuous short cycling of a coaxial direct vented appliance can indicate a leaking venting system, where flue gas is being drawn into the combustion air

Perform Test

Some manufacturers recommend that a leak test be performed at start-up on coaxial direct vent systems

Measure CO2

You can check this by measuring the CO2 concentration of the combustion air in the annular gap of the air intake pipe

Interpret Results

The vent pipe is considered sufficiently leak-proof if a CO2 concentration in the combustion air no higher than 0.2% or an O_2 concentration no lower than 20.6% is measured relative to a starting O2 concentration of 20.9%

Condensation Leakage

Efficiency Factors

With appliances operating at average steady state efficiencies of 75 to 80%, the probability of condensed water dripping from Type B is so low that you can consider it negligible. This applies to most draft hood equipped appliances.

When steady state efficiencies rise above 80% and the appliance has no draft hood, the water vapour concentration in the vent will be higher; thus, water can condense at a higher temperature (as there is higher dew point because there is no draft hood dilution air).

Risk Factors

If the vent gases undergo excessive cooling, as with long laterals in cold, unheated locations, condensation leakage occurs if the vent does not warm up or there are repeated short operating cycles.

Condensate leakage is also a possibility if you use a Type B vent on a Category II or Category IV appliance. The gravity venting capability of a Category II appliance is marginal, and it is not possible to determine a usable minimum capacity. Any Type B gas vent used on either a Category II or Category IV appliance is not allowed, will cause serious problems, and should be replaced with a vent suitable for the application.

Gas and Condensate Leakage

Category IV Appliances

A Category IV appliance, falling in the very high efficiency class, produces positive vent pressure and very wet flue products at a temperature that is too low for gravity venting.

Special Venting Requirements

Category IV appliances require "special gas vents", the type of which may be furnished or specified by the appliance manufacturer. There is no other choice.

	Natural Draft (Negative Pressure)	Pressurized Draft (Positive Pressure)
Non-condensing	Category I - Not airtight - Type B gas vent or listed Chimney Lined System, Type "L"*	Category III - Airtight or Gastight - Corrosion resistant - Vent system specified by manufacturer - UL 103 listed product is required
Condensing	Category II - Watertight & corrosion resistant - Vent system specified by manufacturer - UL 1738 Listed vent required.	Category IV - Gastight, watertight, condensate-drained - Vent system specified by manufacturer - (PVC, AL.29-4C grade stainless steel) - UL 1738 listed product is required

Blocked Venting Systems

An inspection cap located at the base of the vent or a chimney cleanout opening provides the most convenient means of enabling inspection and cleanout of blocked venting systems.

Incorrectly sized vent caps have also been known to contribute to spillage problems.

If too small a vent cap is installed, it can cause flue gases to back up and spill into the building.

Check the size and capacity of vent caps carefully, and install only caps and base-tees certified for use with the manufacturer's venting system.

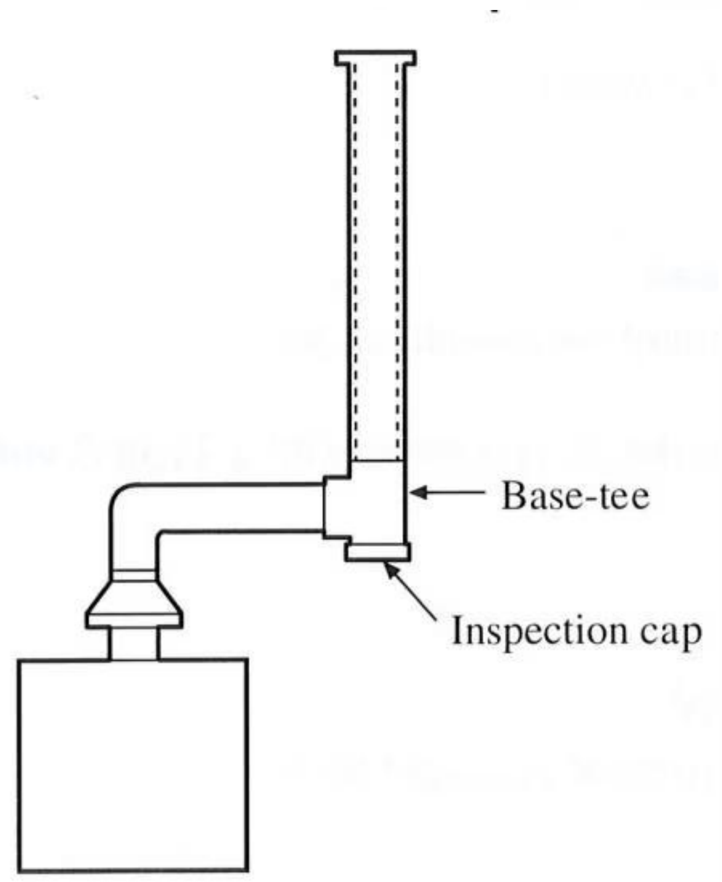


Figure 5-3 Correct location of inspection cap

CSA Unit 22

Chapter 6
Combustion Air Supply for Gas Appliances

The gas technician/fitter must distinguish between airtight buildings and install an air supply that will ensure the appliance operates safely and efficiently.

Learning Objectives

Describe methods of providing combustion air

Understand the different approaches to supplying adequate air for combustion

Explain room air vs direct vent air supply

Differentiate between systems that draw air from the room versus direct from outside

Explain direct vent air supply methods

Understand concentric pipe and twin pipe configurations

Review different building types

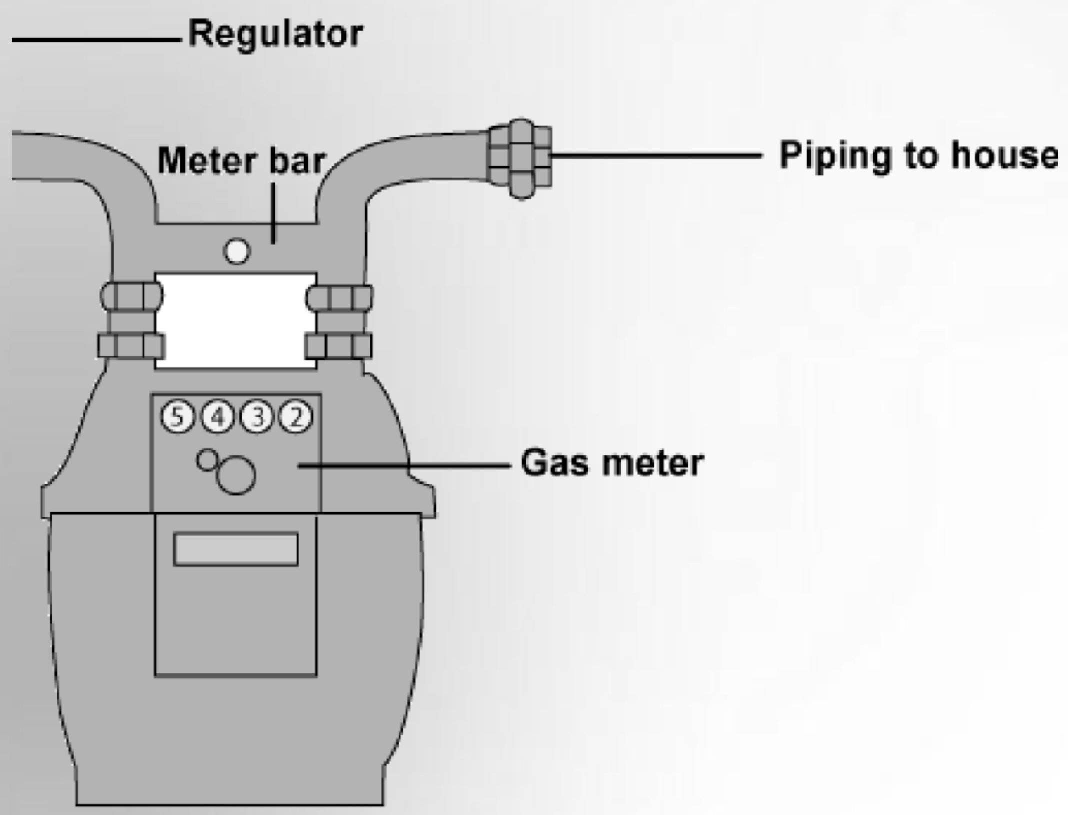
Identify how building construction affects air supply requirements

Describe room air supply requirements

For equipment with inputs of 400 MBtu/h (120 kW) or less

Describe room air supply requirements

For equipment with inputs over 400 MBtu/h (120 kW)



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Key Terminology

Building with a tight envelope

Building that does not permit air infiltration from outside.

Room air systems

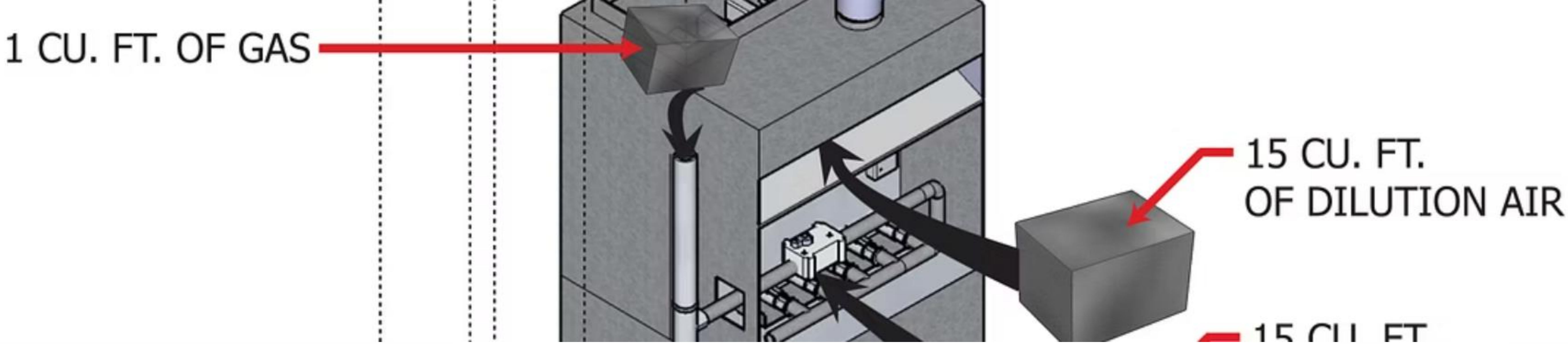
Systems where appliances draw combustion air from the internal room air.

Direct vent systems

Systems with sealed combustion chambers where all air for combustion is taken from outside.

Concentric pipe

A venting configuration where combustion air and exhaust flow through a single connection with hot exhaust exiting through the interior tube.



Methods of Providing Combustion Air

All gas appliances require an adequate supply of air for safe, efficient combustion and control of the venting system. The air supply requirement and method of delivery are dictated by the type of gas appliance. Higher-efficient appliances require less air than natural draft appliances and often have the air supply piped directly to them.

For all gas appliances, the source environment of the air supply is critical. Combustion air must be free of corrosive chemicals and excessive local atmospheric pressure fluctuations.

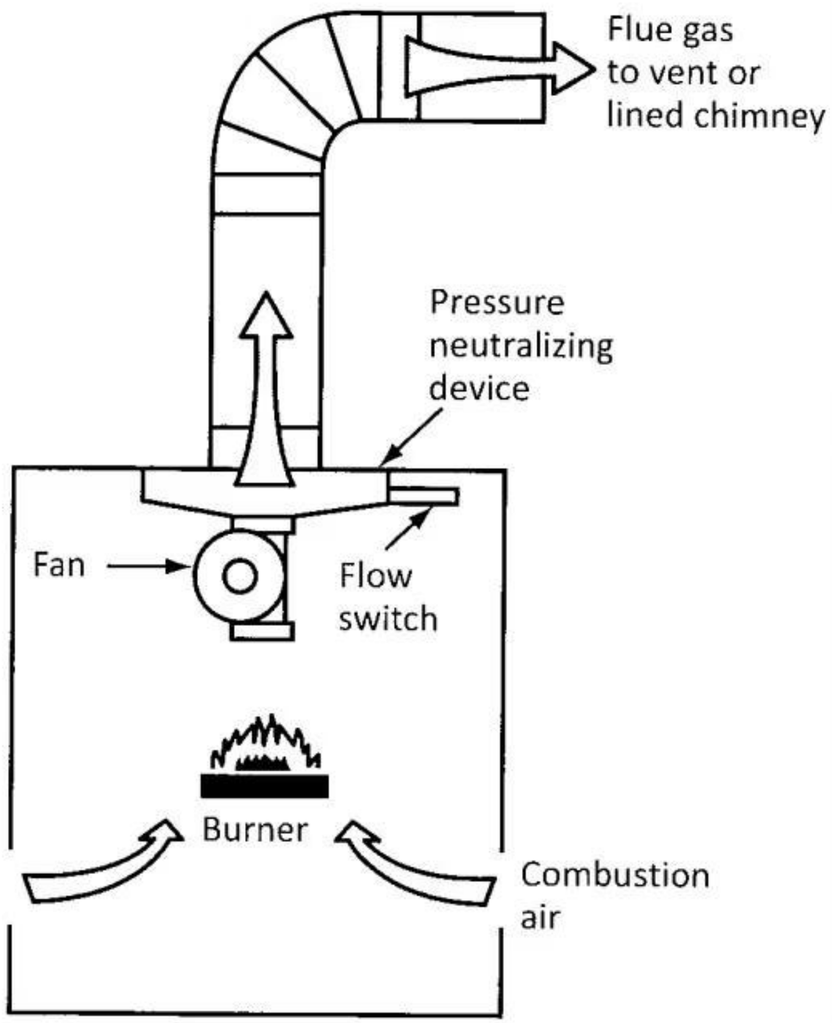
There are two common methods of appliance air supply: direct vent systems and room air systems (non-direct vent).

Room Air Systems

Mid- and lower-efficient appliances have unsealed combustion chambers and draw all air supply requirements from the internal room air.

In some large warehouse-type buildings, there is enough combustion air within the building's structure. Even in these instances, the indoor air supply may not be suitable where is excessive dust or corrosive atmospheric conditions.

For a room air dependent gas appliance, the outside air is normally brought to the gas appliance burner in two ways: via ducts or through a hole in the wall. These methods are referred to as passive air supply compared to a mechanical air supply such as a fan.



If a mechanical air supply is used, it must be properly sized and interlocked with the appliances to shut off the gas in the event of an air supply failure.

Direct Vent Systems Overview

The majority of modern appliances are of the direct vent type, which have a sealed combustion chamber where all air for combustion is taken from the outside atmosphere as well as the products of combustion are discharged to the outdoors.

Enhanced Safety

Sealed combustion chambers prevent combustion gases from entering living spaces

Improved Efficiency

Direct venting reduces heat loss and improves overall appliance performance

Flexible Installation

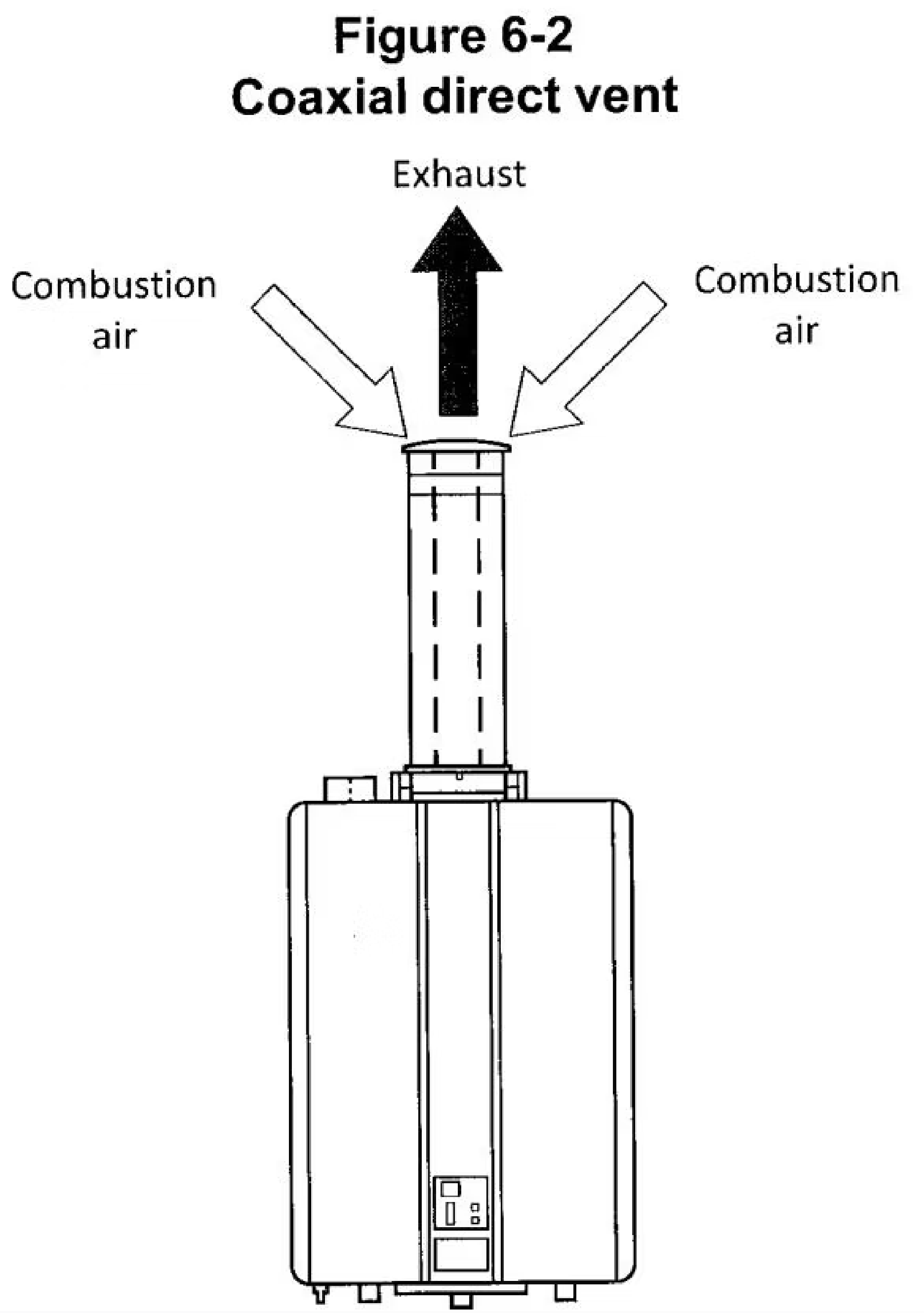
Can be installed in various configurations to suit different building requirements

Concentric Coaxial Pipe Systems

How Concentric Vents Work

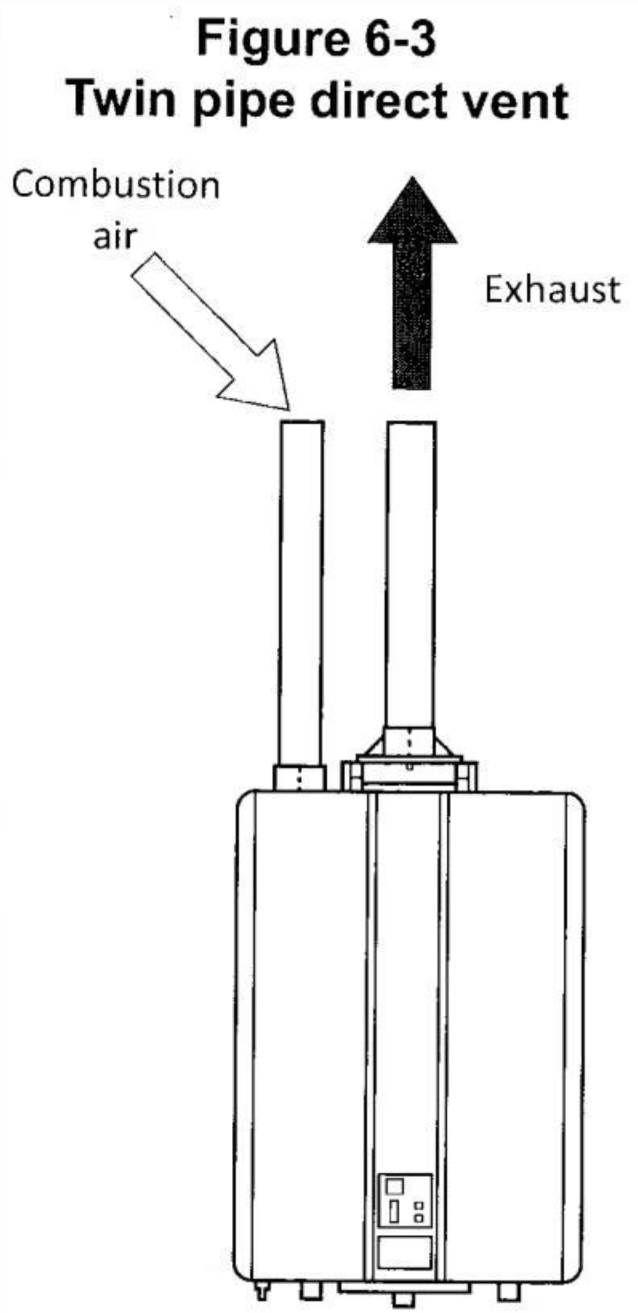
For coaxial vents, the combustion air and exhaust flow directly through a single connection to the appliance. Hot exhaust exits through the interior tube, while combustion air enters through the outer layer.

This design creates an efficient system where incoming air is preheated by the exhaust, improving overall efficiency.



Concentric pipe systems provide a clean, compact installation with only one

Twin Pipe Direct Vent Systems



Twin pipe systems require two separate penetrations through the building

Twin Pipe Configuration

For twin pipe direct vent systems, the combustion air and exhaust flow directly through separate pipes and penetrations.

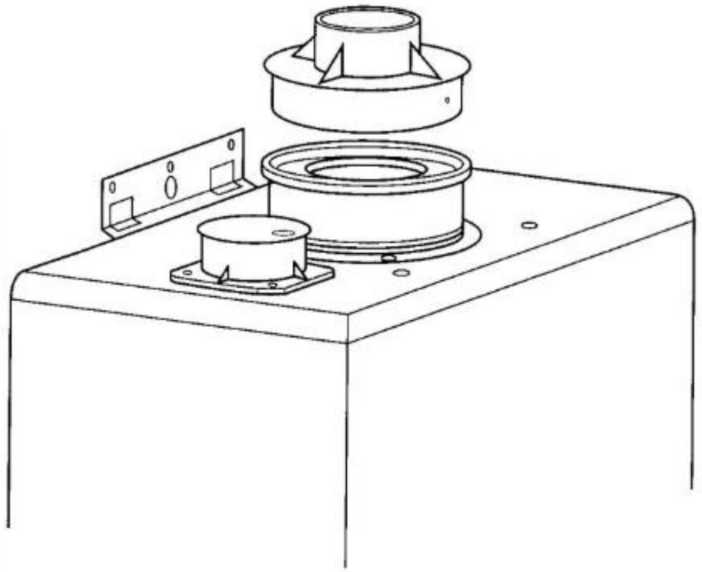
This configuration allows for more flexibility in installation, as the intake and exhaust can be positioned in different locations to optimize performance.

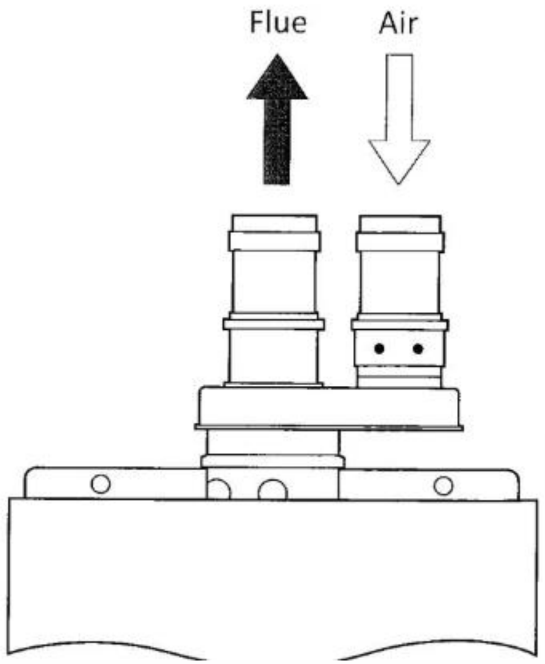
Twin pipe systems are often used when longer vent runs are required, as they can provide better flow characteristics in certain installations.

Direct Vent Starter Adapters

Many direct vent appliances are designed to be installed using either vent piping option through various manufactures' starter adapters.

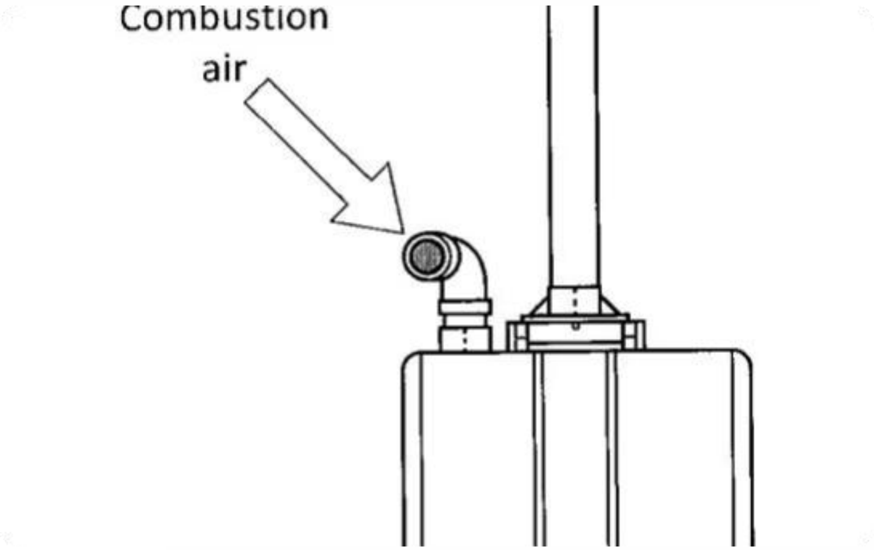
These adapters allow for flexibility in installation, enabling technicians to choose the most appropriate venting system for the specific application and building requirements.

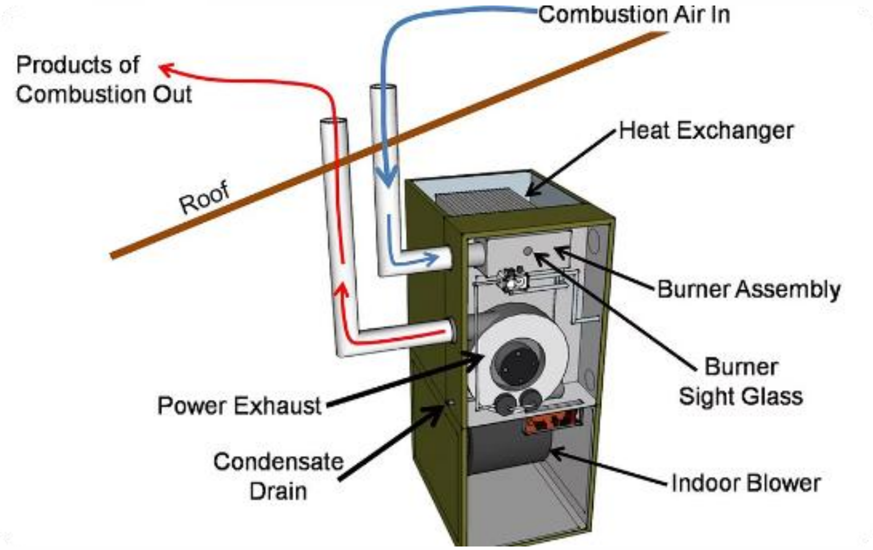




Examples of direct vent starter adapters that convert between different venting configurations.

Direct Vent as Room Air Dependent





Dual-Mode Operation

Direct vent appliances may also be installed as room air dependent systems, where the room air supply needs to conform to the manufacturer's instructions as well as to CSA B149.1.

Installation Requirements

When installed as room air dependent, proper sizing of air supply openings becomes critical to ensure safe and efficient operation.

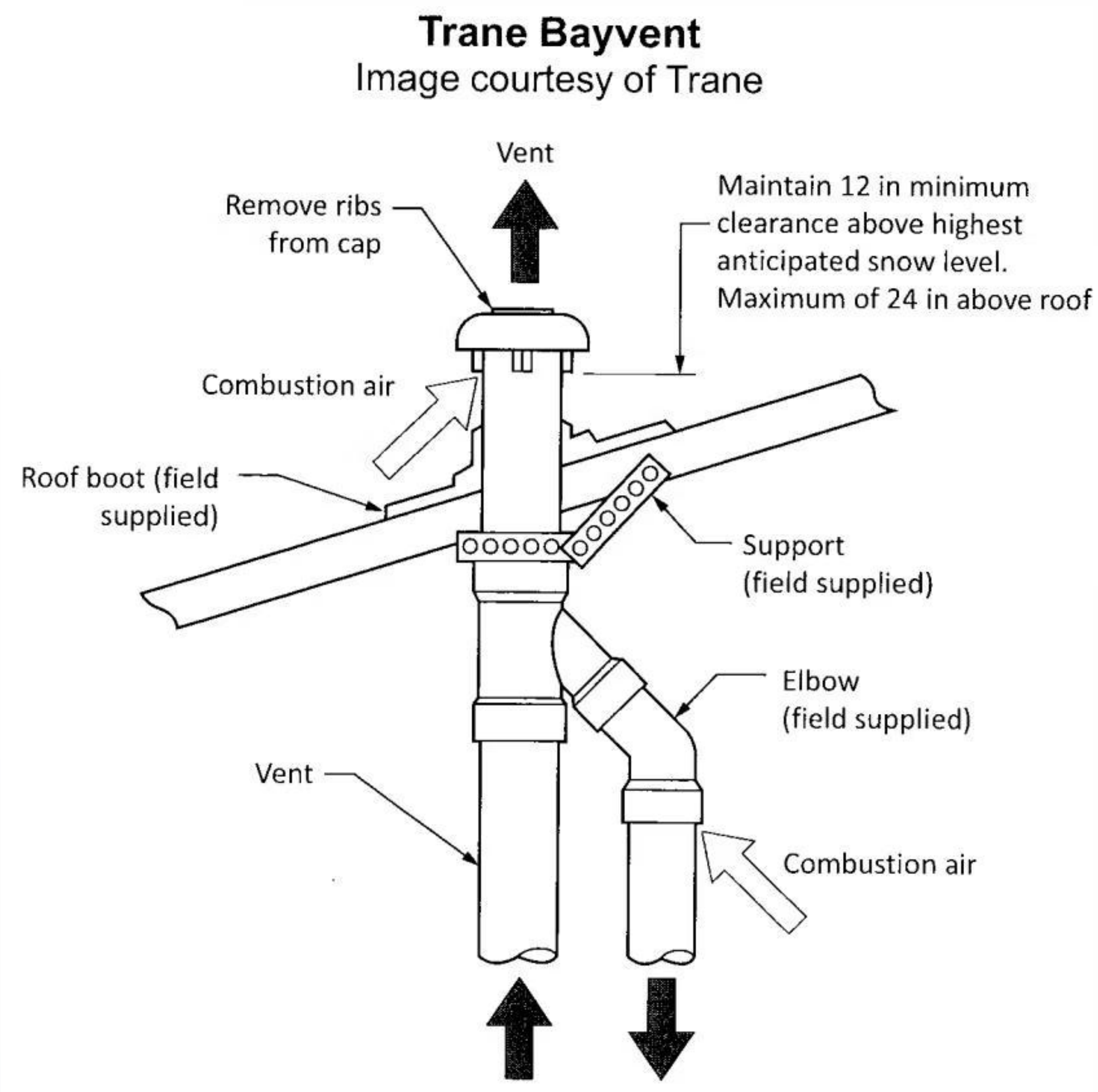
Manufacturer Guidelines

Always follow manufacturer's certified instructions for proper installation configuration.

Direct Vent Termination Options

There are also many termination options available for direct vent systems, including adapters that enable the installer to convert a two-pipe system to a concentric termination.

These termination options provide flexibility in installation while maintaining the safety and efficiency benefits of direct venting.



Concentric vent roof installation showing how the system terminates through the

Direct Vent Installation Considerations

Follow Manufacturer Instructions

Critical that installations be completed per manufacturer's certified instructions

Select Proper Materials

Use only approved venting materials specified by the manufacturer

Choose Appropriate Configuration

Select concentric or twin pipe based on installation requirements

Proper Termination

Ensure vent terminations meet code requirements for clearances

Ventilation and Ducting Requirements

CSA B149.1 Compliance

Air-supply openings and ducts must comply with Clauses 8.3 and 8.5

High-Input Appliances

Spaces with appliances exceeding 400 MBtu/h (120 kW) require ventilation openings at the highest practical point

Discharge Opening Placement

Must be located where cold air won't affect pipes and equipment

Inlet Protection

Must not permit entry of rain or wind and must maintain required free area

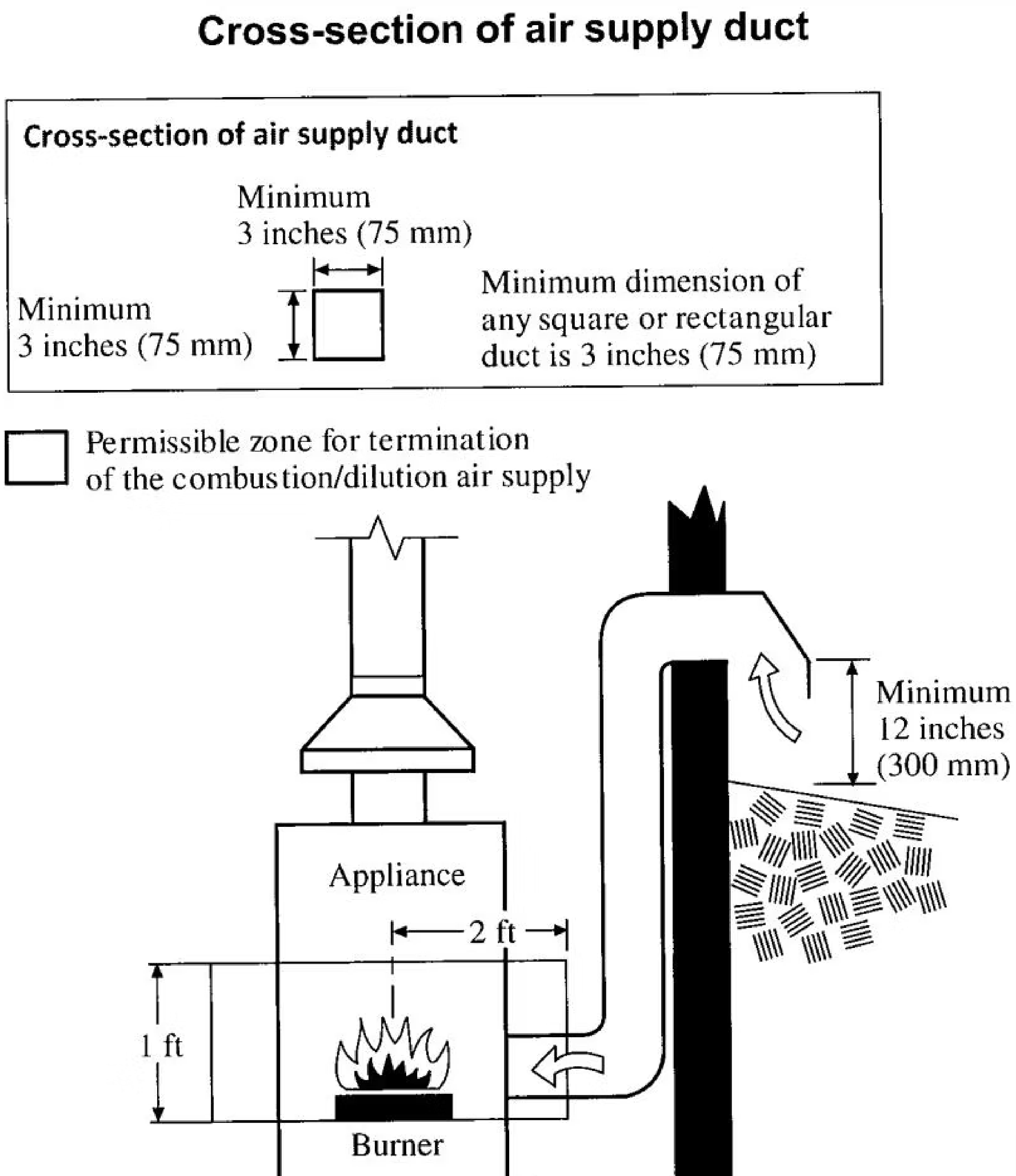
Clearance Requirements

Air-supply opening shall not be located within 3 ft (1 m) of a moisture exhaust duct

Air Supply Opening Placement

The discharge opening of an air supply duct must be located where cold air will not affect steam or water pipes and electrical or mechanical equipment.

Proper placement ensures that the incoming air doesn't create adverse conditions for other building systems and components.



Air Supply Opening Requirements

Calculating Free Area

To calculate the free area of an air supply opening, subtract blockage areas of fixed louvres, grilles, or screens from the gross opening area.

Free area = gross area - Blockage area of louves, grilles, or screens

Minimum Aperture Size

The smallest dimension of aperture in a fixed louvre, grille, or screen is 0.25 inches (6 mm).

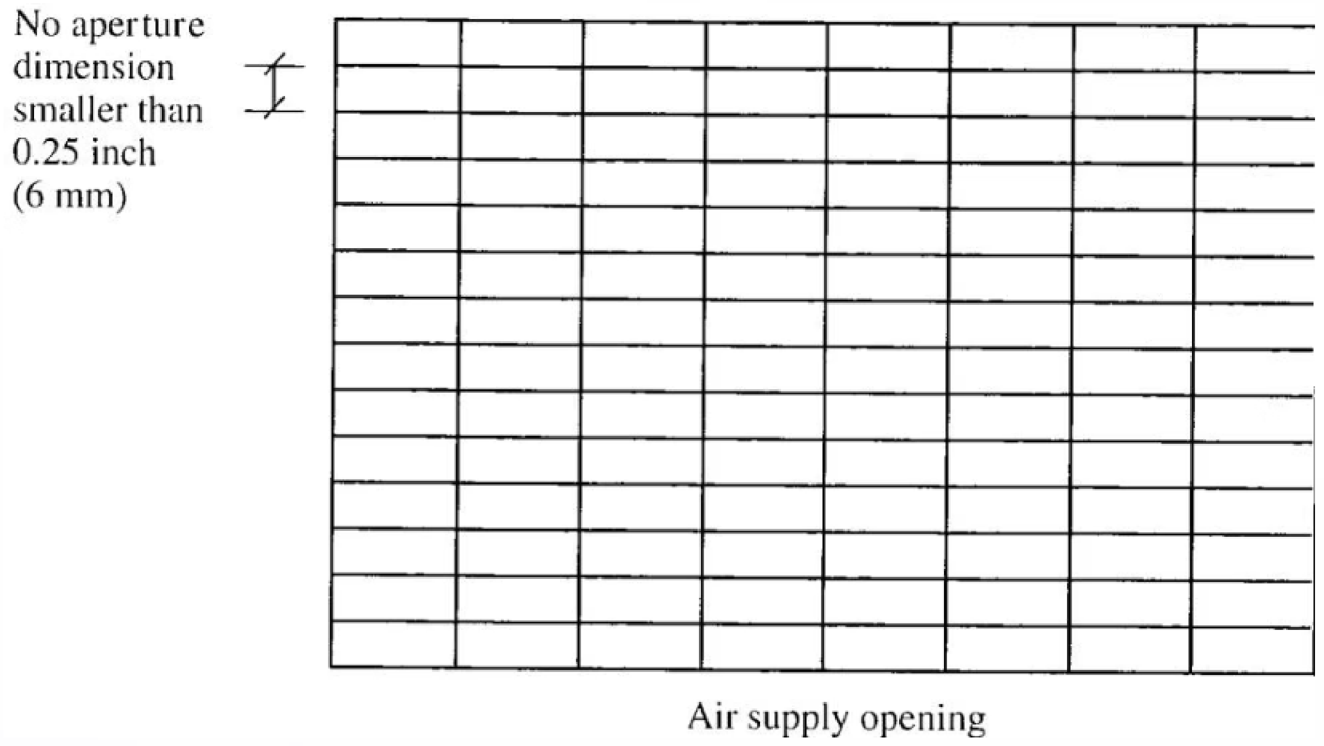


Diagram showing how to calculate the free area of an air supply opening by accounting for blockages.

Damper Requirements for Air Supply

Manual Dampers Prohibited

The use of manually operated dampers or manually adjustable louvres is not permitted.

Automatic Damper Interlocking

An automatically operated damper or automatically adjustable louvre shall be interlocked so the main burner cannot operate unless either the damper or louvre is fully open.

Certification Requirement

Automatic combustion air dampers installed in the air supply of a dwelling shall be certified.

Safety Considerations

These requirements ensure that combustion air is always available when the appliance is operating, preventing dangerous conditions.

Length of Air Supply Ducts

Flow Restrictions

When the air supply duct or pipe is being used for a direct vent or a room air system and when the pipe or duct is too long, it will restrict the flow of air.

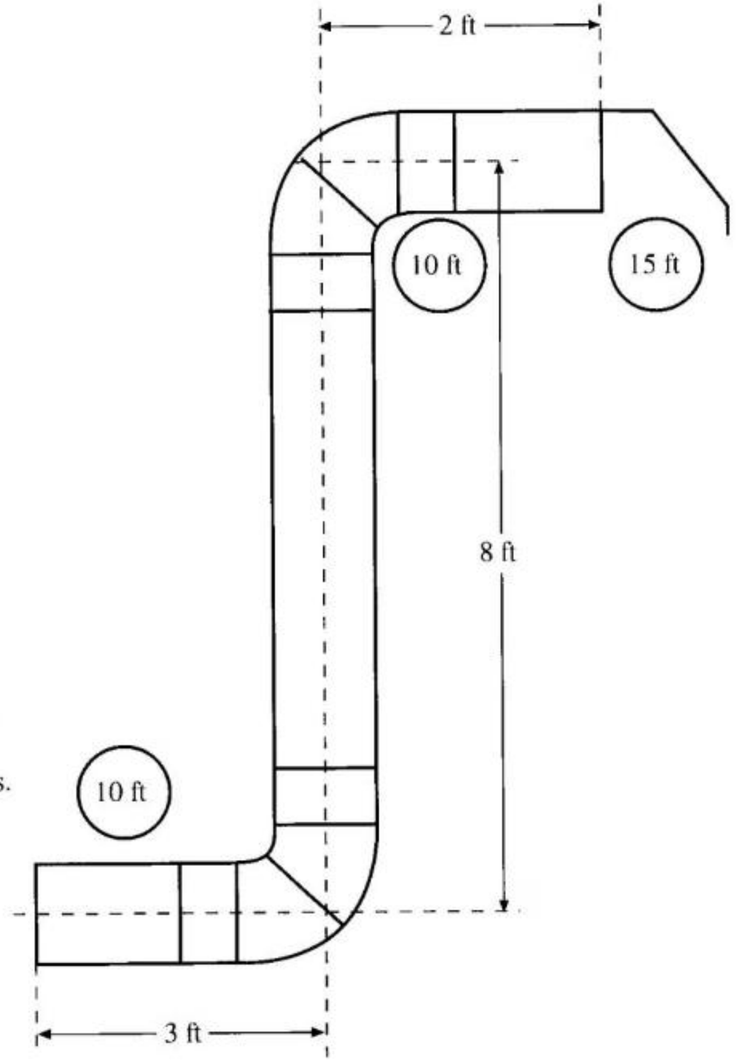
Fittings also create addition resistance to flow, so pipes should be routed as directly as possible with as few bends as possible.

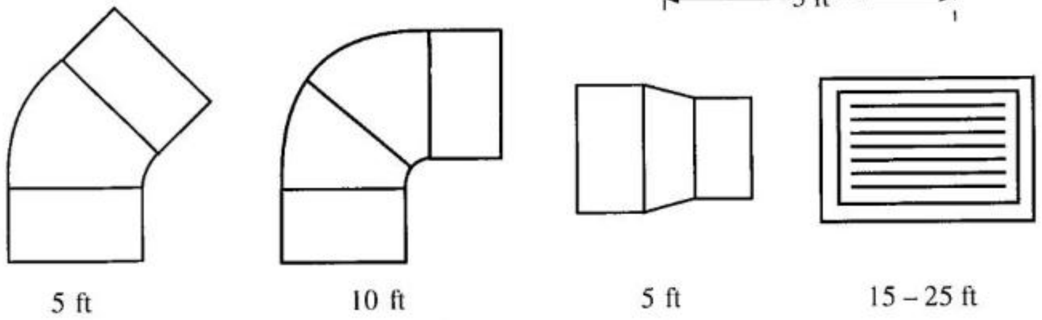
Tables 8.1 and 8.2 are used to size the outside air supply and are limited to a maximum effective duct length of 50 ft (see the second note at the bottom of these tables, and replace "equivalent" with "effective"). Beyond this length of resistance some form of mechanical air supply should be considered.

The effective length of a duct is calculated by determining its actual and equivalent lengths. This actual length can be measured, and the equivalent length of the fittings and grilles added to obtain the effective length represents the resistance of all of the piping, fittings, and grilles expressed as a length of straight duct.

In the example shown here, the actual length is equal to 3 ft + 8 ft + 2 ft = 13 ft. The equivalent length (shown in the circles), is equal to 10 ft + 10 ft + 15 ft = 35 ft.
The effective length is equal to 13 ft + 35 ft = 48 ft.

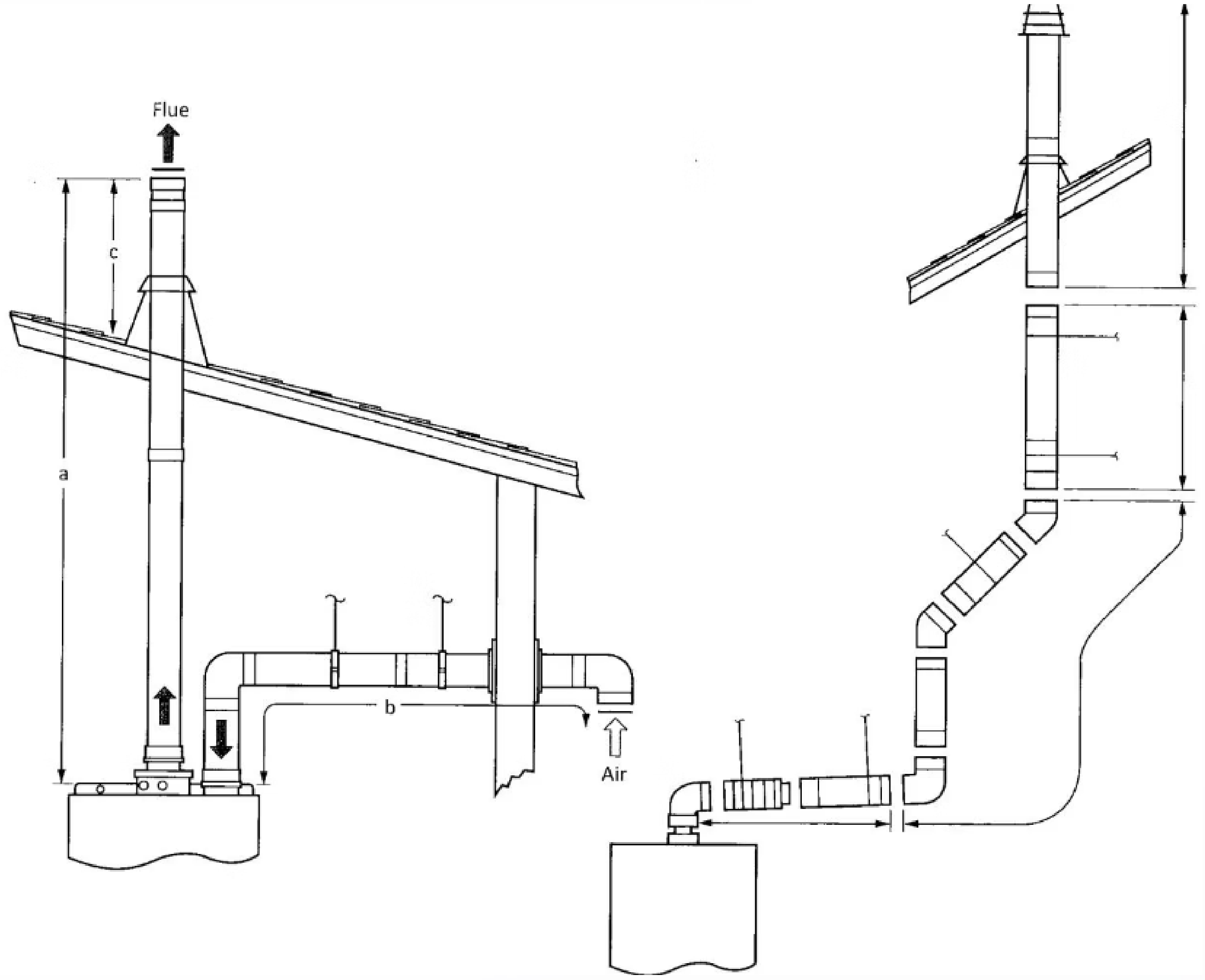
Because the effective length of the duct is greater than 20 ft, the diameter of the duct would be increased by one size over that required in the tables. If the duct had exceeded 50 ft, then another means of providing outside air would be required.





Double the length for all corrugated ductwork

Direct Vent Equivalent Length



Direct vent equivalent length diagrams showing how to measure different configurations.

Manufacturer Specifications

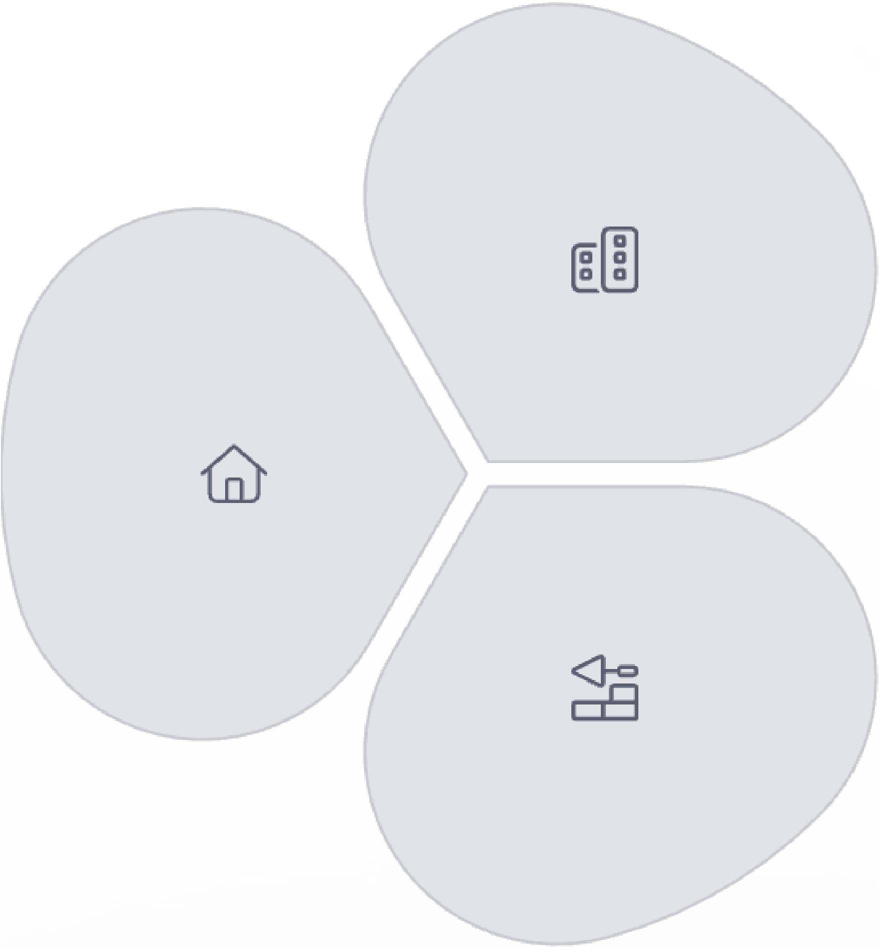
For direct vent systems, the maximum equivalent length is specified in the installation instructions for the type of piping system.

The diagrams show two manufacturers' drawings detailing how the two different vent piping configurations are measured.

There would be a fitting equivalent length table for either fitting types in the manufacturer's instructions.

Notice that the total equivalent length specified for a two-pipe system is the combined length of the exhaust vent/air intake pipe system.

Building Types Overview



Platform Frame

Most common construction type in Canada

Used with brick, stucco, or vinyl veneer housing

Balloon Frame

Older construction method

Continuous studs from foundation to roof

Double/Solid Brick

Traditional masonry construction

Provides thermal mass but different air infiltration characteristics

The three main house construction types in Canada are platform frame, balloon frame, and double/solid brick. Platform frame, used with brick, stucco, or vinyl veneer housing, is the most common. More detailed descriptions of all three construction types are found in Unit 14 The building as a system.

Airtight Building Envelopes

Modern Construction Challenges

With the introduction of new building materials and techniques and the growing emphasis on energy efficiency, modern buildings have become increasingly airtight.

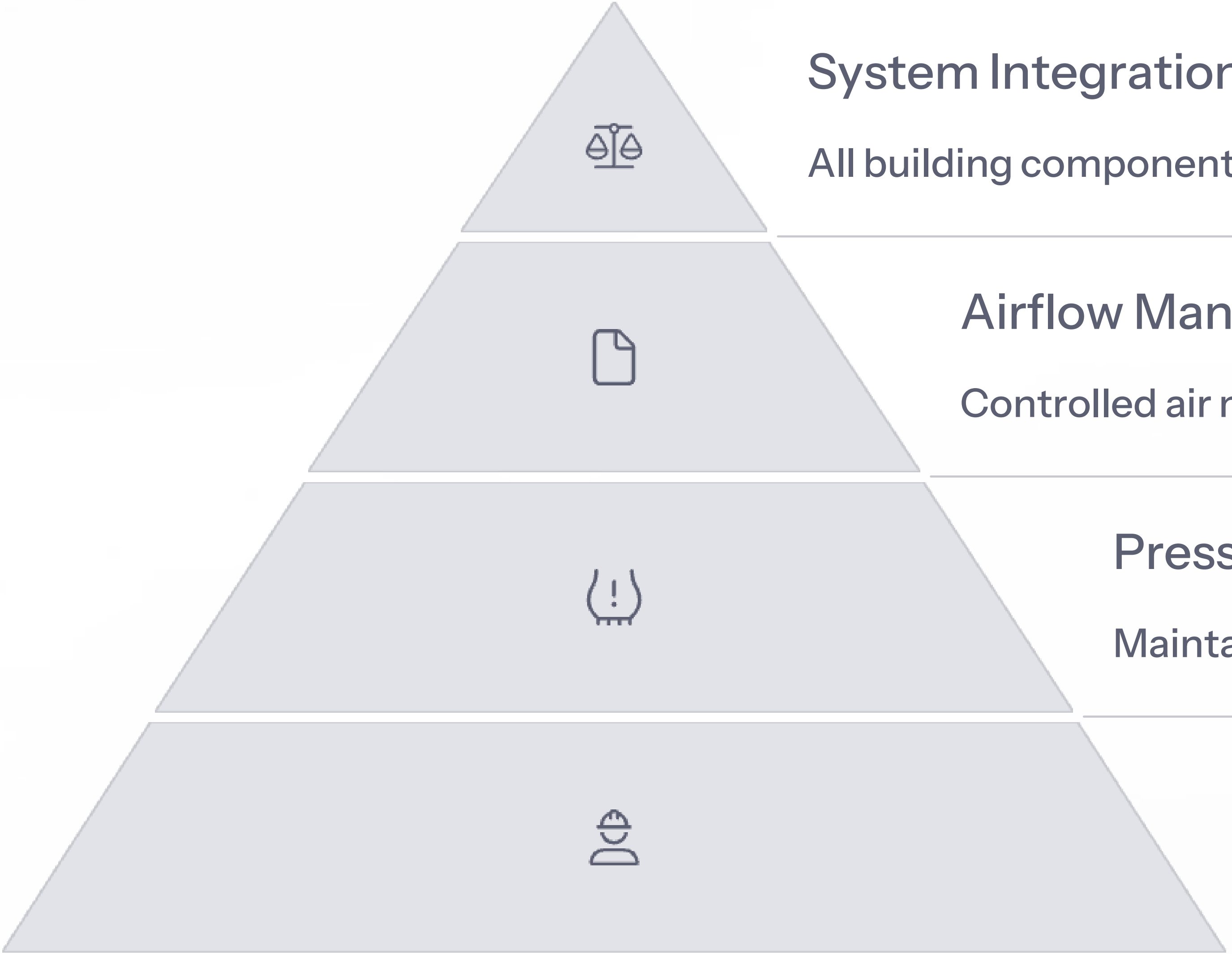
In homes with airtight envelopes, traditional gas appliance performance may be affected in varying degrees. Combustion appliances that operated quite well in the relatively leaky building envelopes of the past may not be so efficient in air-sealed modern buildings or retrofitted homes.

Installer Responsibilities

The ventilation system installer (often the gas appliance installer) is responsible for ensuring that the depressurization requirement is met-i.e., that depressurization in a building with spillage-susceptible appliances must be limited to -0.02 inch w.c. (-5 Pa) to eliminate the risk of spillage.

The installer needs to understand that the operation and air requirements of combustion appliances must work in conjunction with other air exhausting equipment installed in airtight buildings.

Building-as-a-System Principles



System Integration

All building components work together

Airflow Management

Controlled air movement throughout the building

Pressure Relationships

Maintaining appropriate pressure differentials

Occupant Safety

Ensuring health and comfort of building users

Sound knowledge of "building-as-a-system" principles helps to minimize conditions that can affect appliance performance and to ensure the health and safety of the occupants.

Determining Need for Outside Air Supply

Practical Challenges

A practical difficulty is determining whether a building is sufficiently tight to require an outside combustion/dilution air supply. This is often the case when dealing with an existing building that is being renovated or retrofitted.

Most new homes require outside combustion/dilution air. These are usually tightly sealed homes in which a great deal of care has been taken to air-seal the building envelope.

Testing Methods

A fan depressurization test will determine whether the equivalent leakage area is less than 78 square inches, as required in CSA B149.1.

Some authorities having jurisdiction over gas installations provide advisories, bulletins, or amendments to CSA B149.1 that provide further direction on when outside air openings are required.

Ontario's Specific Requirements

> In Ontario, Clause 8.2.1(a) of CSA B149.1-15 has been amended to read as follows: An outdoor air supply sized in accordance with Clause 8.2.2 shall be provided for an enclosure or a structure in which an appliance is installed when the enclosure or structure A) has a vapour or air barrier with joints continuously sealed by taping or caulking in all thermally insulated walls, ceilings and floors

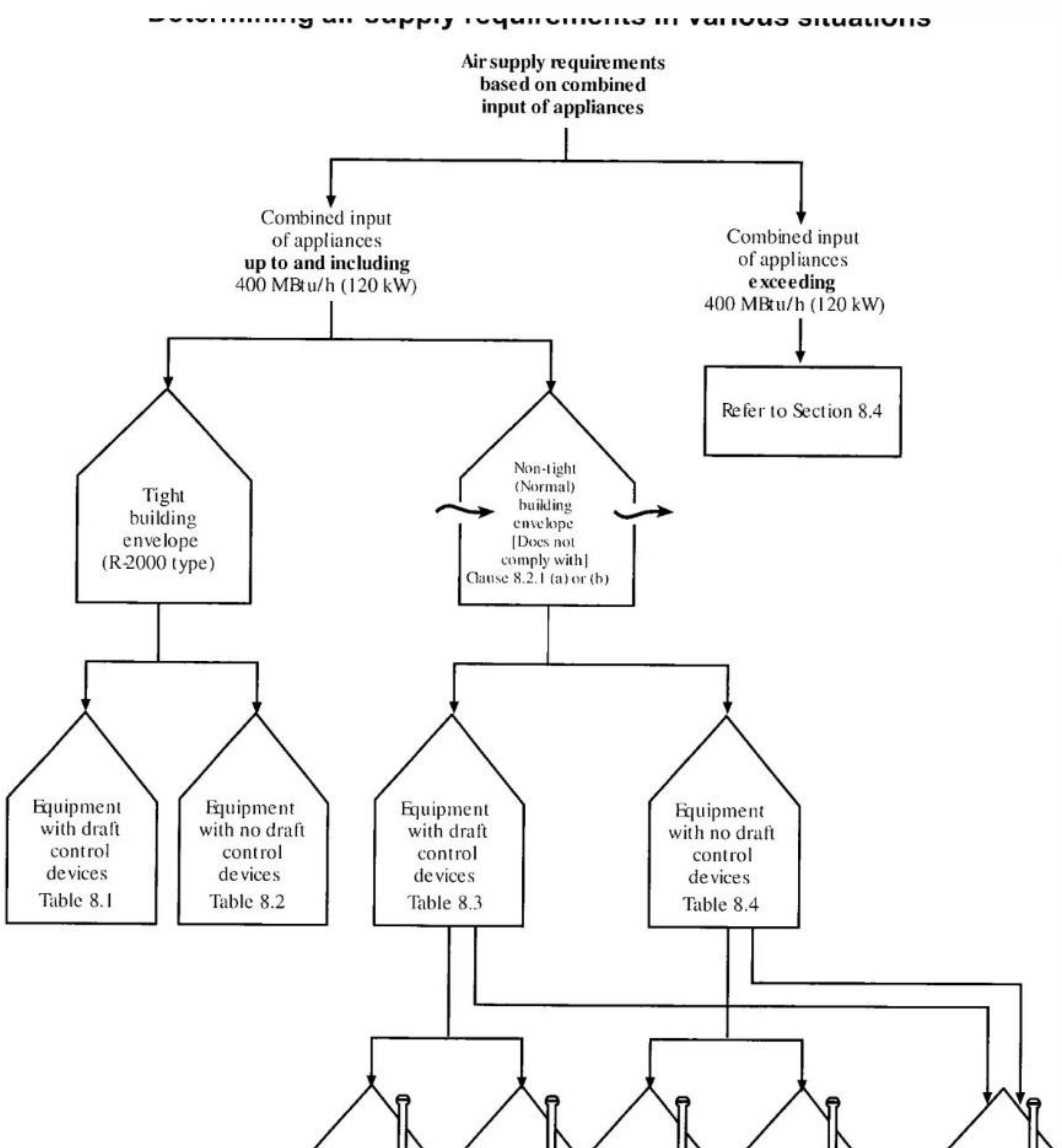
This amendment provides clearer guidance for installers in Ontario regarding when an outdoor air supply is required for gas appliances.

Always check with your local authority regarding the definition of a tightly constructed building, as requirements may vary by jurisdiction.

Air Supply Requirements Flowchart

Figure 6-11 is a flowchart showing different building types and air requirements. This flowchart can be used to determine the air supply requirements applicable to various building types and installations.

The chart provides a systematic approach to evaluating building characteristics and appliance types to determine the appropriate air supply requirements.



Appliances in Sealed Enclosures

Limited Volume Challenge

Where appliances are located in a sealed enclosure without openings to the rest of the building, an outside supply of combustion/dilution air is usually required.

This is because the small volume and surface area of the enclosure cannot provide adequate air supply through air leakage.

Volume Calculation

For this situation, the volume of the enclosure and Table 8.4 of CSA B149.1 should be used to determine air supply requirements.

Alternative Solution

Providing openings in the enclosure that communicate with the rest of the building structure can eliminate the need for outside air supply since the total volume of the structure may be used in the tables.

Code Reference

The method of providing this communication is found in Clause 8.2.6 of CSA B149.1.

When in Doubt About Air Supply

Assess the situation

Evaluate building construction and appliance requirements

Consider testing

Fan depressurization test can provide definitive answers

Provide outside air

When uncertain, install outside air supply for safety

When in doubt, an outside air supply may be provided, recognizing that it represents an added cost to the consumer that may not actually be necessary. From a practical point of view, if no problems are being experienced in homes without outside air supply to gas appliances in an area, it is unlikely that an outside air supply is required. However, if there are any doubts, an outside air supply should be provided.

Purpose of Combustion Air Supply

Clean Air for Combustion

The main purpose of the combustion air supply is to provide a clean air supply for combustion.

For example, many furnaces and boilers are located in laundry rooms whose atmosphere is exposed to bleach that can react with products of combustion and corrode heat exchangers.

Preventing Contamination

An outside fresh air opening can reduce the likelihood of contaminated air being used by the appliance.

This helps protect the appliance components from premature failure and ensures proper combustion without harmful byproducts.

Air Requirements for Equipment ≤ 400 MBtu/h

The Clauses and corresponding Tables in Section 8 of CSA B149.1 show various venting and air supply requirements for appliances with a total input of 400 MBtu/h (120 kW) and less. The Tables indicate the minimum size of the required air supply in relation to the combined input of the gas appliances.

Identify Equipment Type

Determine appliance type and location

Assess Building Construction

Determine if building is tightly constructed

Check Draft Control

Determine if appliance has draft control device

Select Appropriate Table

Use correct CSA B149.1 table based on findings

Key Considerations for Air Supply

Appliance Type and Location

CSA B149.1 indicates which Table to use to size air supply systems for central heating furnaces, boilers, and hot water heaters.

Building Construction

CSA B149.1 addresses the problem of insufficient air infiltration in airtight buildings that fails to provide enough air supply for gas-fired equipment.

Appliance Draft Control

If an appliance is designed to operate with a draft control device, it will require a larger volume of air supply than equipment designed to operate with no draft control device.

Other Appliances Air Supply Requirements

> When an appliance other than a central-heating appliance or a domestic water is installed in a location where there is insufficient air for combustion, provisions shall be made to provide an air supply sized in accordance with Table 8.1 or 8.2.

Although the Code does not specifically name other appliances beyond central heating furnaces, boilers, and hot water heaters, Clause 8.1.5 provides guidance for other types of gas appliances.

This ensures that all gas appliances, regardless of their specific function, receive adequate combustion air for safe and efficient operation.

Defining Tightly Constructed Buildings

CSA B149.1 Definition

Clause 8.2.1 of CSA B149.1 defines a tightly constructed building as one that:

a) has windows and doors of either close-fitting or sealed construction, and the exterior walls are covered by a continuous, sealed vapour barrier and gypsum wallboard (drywall) or plywood or a similar material having sealed joints; or

b) has an equivalent leakage area of 78 in^2 (0.05 m^2) or less at a differential pressure of 0.00145 psig (10 Pa) as determined by a recognized Canadian fan depressurization test procedure.

Regional Variations

As indicated previously, some jurisdictions like Ontario have amended the requirements pertaining to outside air supply requirements to clarify these requirements.

Always check with your local authority regarding the definition of a tightly constructed building, as interpretations may vary.

Air Volume Requirements by Appliance Type

15:1

Combustion + Excess Air

Combined ratio for basic combustion requirements

15:1

Dilution Air

Additional ratio required for flue gas dilution

2x

Total Volume

Appliances with draft control use twice the air volume

The volume of air required for the operation of gas-fired equipment was discussed in detail earlier in this course. The combustion air and excess air requirements make a combined ratio of 15:1. The dilution air required for flue gas is also at a ratio of 15:1. An appliance that requires dilution air uses twice the volume of air as an appliance that does not.

Tables for Sizing Air Supply Ducts

CSA B149.1 Table	Title	Use when the structure
Table 8.1	Combustion/dilution air requirements for appliances having draft control devices when the combined input is up to and including 400 000 Btu/h (120 kW) and the structure complies with Clause 8.2.1 a) or b).	Is tightly constructed and the equipment has a draft control device.
Table 8.2	Combustion air requirements for appliances not having draft control devices when the combined input is up to and including 400 000 Btu/h (120 kW) and the structure complies with Clause 8.2.1 a) or b).	Is tightly constructed and the equipment has no draft control device.
Table 8.3	Combustion/dilution air requirements for appliances having draft control devices when the combined input is up to and including 400 000 Btu/h (120 kW) and the structure does not comply with Clause 8.2.1 a) or b).	Is not tightly constructed and the equipment has a draft control device.
Table 8.4	Combustion air requirements for appliances not having draft control devices when the combined input is up to and including 400 000 Btu/h (120 kW) and the structure does not comply with Clause 8.2.1 a) or b).	Is not tightly constructed and the equipment has no draft control device.

Selecting the Correct Table

Ask Key Questions

Is the building tightly constructed?

Does the equipment have a draft-hood or other draft control device?

Find Answers

Assess building construction

Inspect appliance configuration

Select Table

Choose appropriate table from CSA B149.1

Tables 8.1, 8.2, 8.3, or 8.4

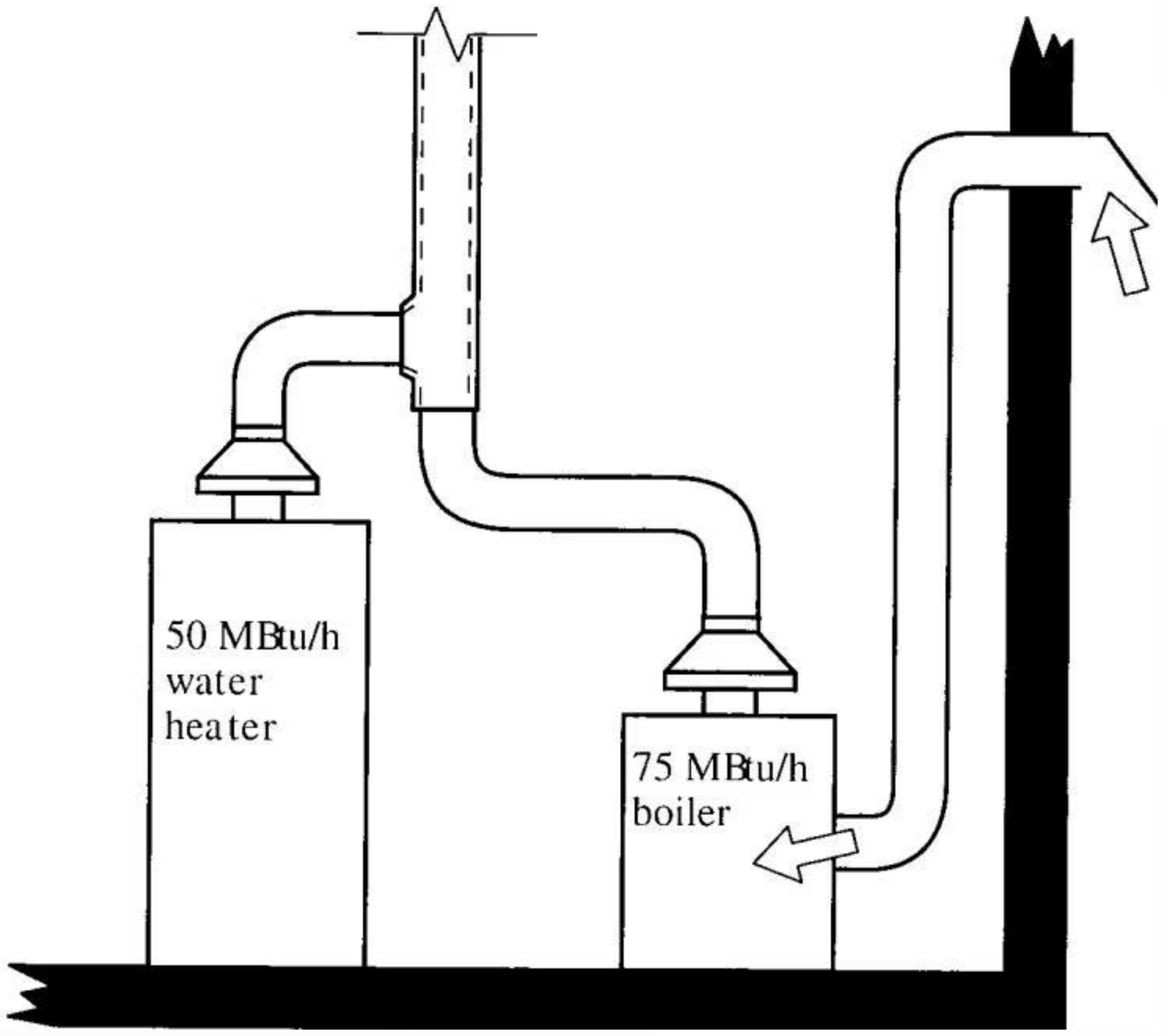
Appliances in Airtight Buildings

An outside air supply must always be provided to gas appliances that are installed in buildings with a tight envelope (buildings that do not permit air infiltration from outside). An opening or duct to the outdoors is the source of the air supply.

With Draft Control Devices

If all of the appliances are equipped with draft control devices, the procedure is straightforward, use Table 8.1 of CSA B149.1.

For example, with a combined appliance input of 125 MBtu/h, the required free area of air supply opening would be 18 square inches, with an approximate equivalent round duct diameter of 5 inches.



Both appliances have draft control devices in a building with an airtight envelope.

Example 1: Appliances with Draft Control

Scenario

A single-family dwelling is tightly constructed--complying with Clause 8.2.1 a) or b). It has a boiler rated at 200 MBtu/h and a hot water heater rated at 90 MBtu/h. Both appliances are equipped with draft control devices. The air supply is brought from outdoors through a duct.

Calculation

Refer to Table 8.1:

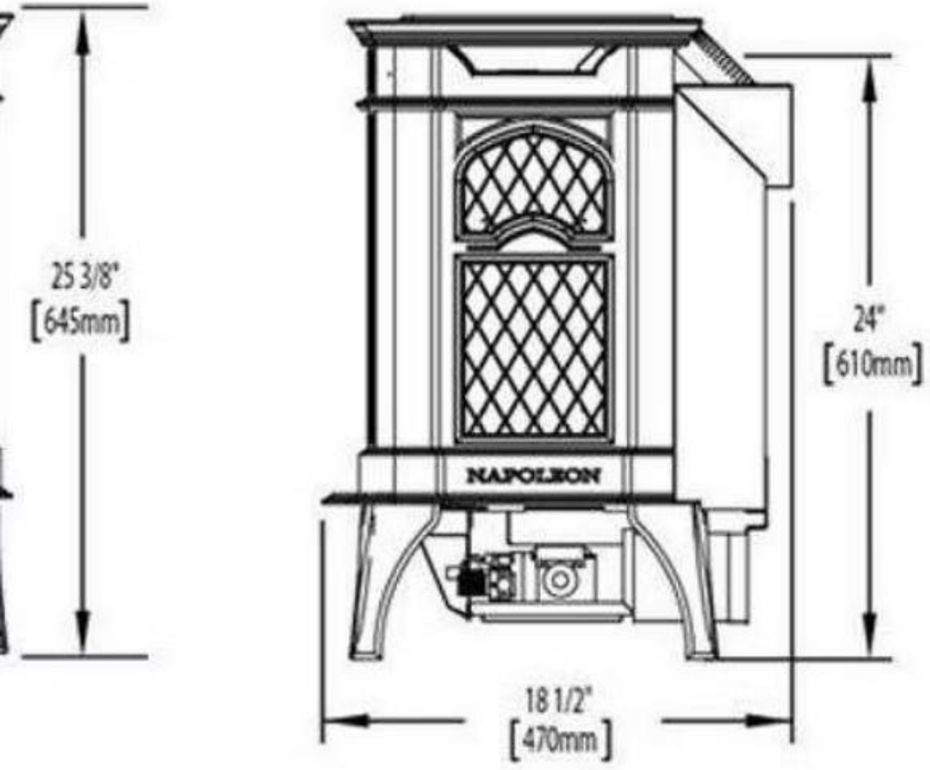
Total input = 290 Mbtu/h

Use next-largest input = 300 MBtu/h

Result

Area of air supply duct = 43 square inches

Round duct equivalent = 7 inches



Example 2: Appliances Without Draft Control

Scenario

An airtight structure conforms to Clause 8.2.1 a) or b). It contains a boiler rated at 100 MBtu/h and a hot water heater rated at 36 MBtu/h. Both appliances are designed for use with no draft control devices. The air supply is brought from outdoors through a duct.

Calculation

Refer to Table 8.2:

Total input = 136 MBtu/h

Use next-largest input = 150 MBtu/h

Result

Area of air supply duct = 11 square inches

Round duct equivalent = 4 inches

Mixed Appliance Types in Airtight Buildings

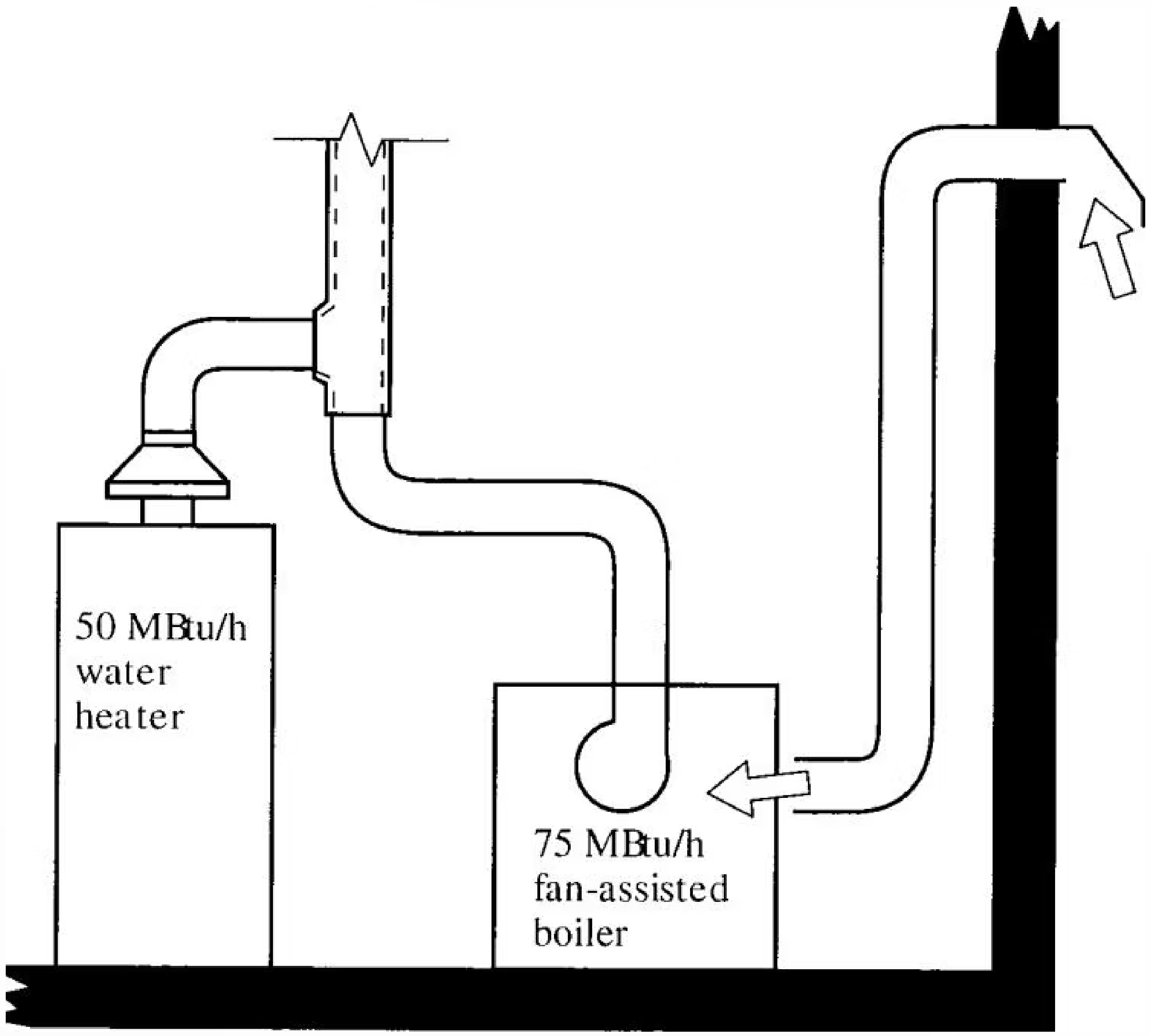
Code Requirements

In cases where both types of appliances are installed in the same airtight building (where one appliance has a draft-control device and the other does not), Clause 8.2.5 of CSA B149.1 provides specific guidance.

The required free area of the air supply opening shall be the greater of:

a) that required by Table 8.1, using the total input of only those appliances having draft-control devices: or

b) that required by Table 8.2, using the total input of all appliances.



One appliance with draft control, the other without draft control (fan-assisted).

Example 3: Mixed Appliance Types

Scenario

A structure is tight [it conforms to Clause 8.2.1 a) or b)]. It has a mid-efficient furnace rated at 100 MBtu/h and a hot water heater rated at 40 MBtu/h. The furnace has no draft control device, but the hot water tank is equipped with a draft-hood. The air supply is from outdoors.

Calculation for Draft Control Appliance

Refer to Table 8.1:

Input of appliance with draft control = 40 MBtu/h

Use next-largest input = 50 MBtu/h

Size = 7 square inches

Calculation for All Appliances

Refer to Table 8.2:

Total of all inputs = 140 MBtu/h

Use next-largest input = 150 MBtu/h

Area of air supply duct = 11 square inches

Round duct equivalent = 4 inches

Appliances in Non-airtight Buildings

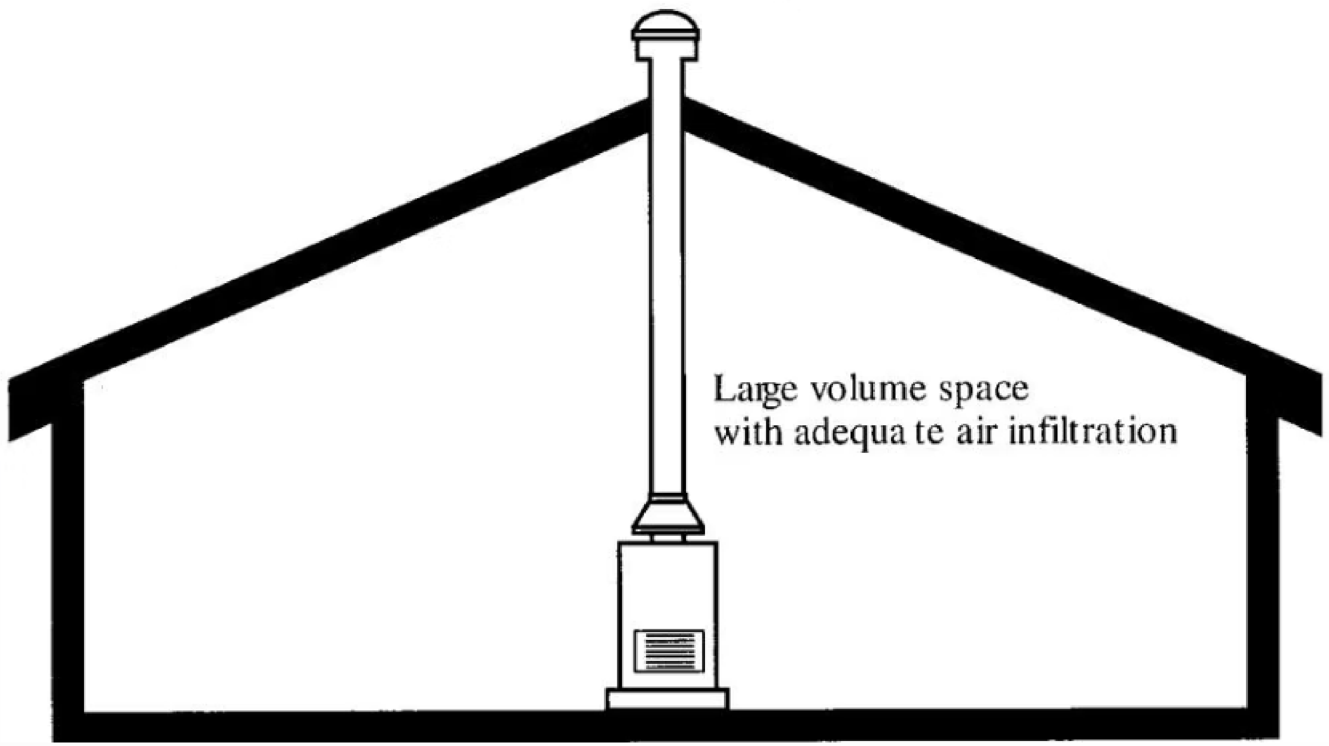
Building Characteristics

Non-airtight buildings ("leaky" or "normal" buildings that are not extremely airtight) include some new housing as well as existing buildings-those that do not conform to Code Clauses 8.2.1 a) or b).

The requirements for outside air supply for such buildings are based on the combined input of the appliances, their draft control characteristics, and the volume of the structure.

Volume Considerations

If the structure has a large enough volume, sufficient air supply is delivered through normal air leakage and no additional openings are required.



Equipment installed in building with enough air volume.

Example 4: Non-airtight Building

Scenario

A non-airtight structure [that does not comply with Clause 8.2.1 a) or b)] is equipped with a boiler rated at 150 MBtu/h and a hot water rated at 60 MBtu/h. Both appliances are equipped with draft control devices. The volume of the structure is 10,000 cu ft.

Calculation

Refer to Table 8.3:

Total input = 210 MBtu/h

Use next-largest input = 225 MBtu/h

For under 10,000 cu ft volume

Result

Area of air supply duct = 32 square inches

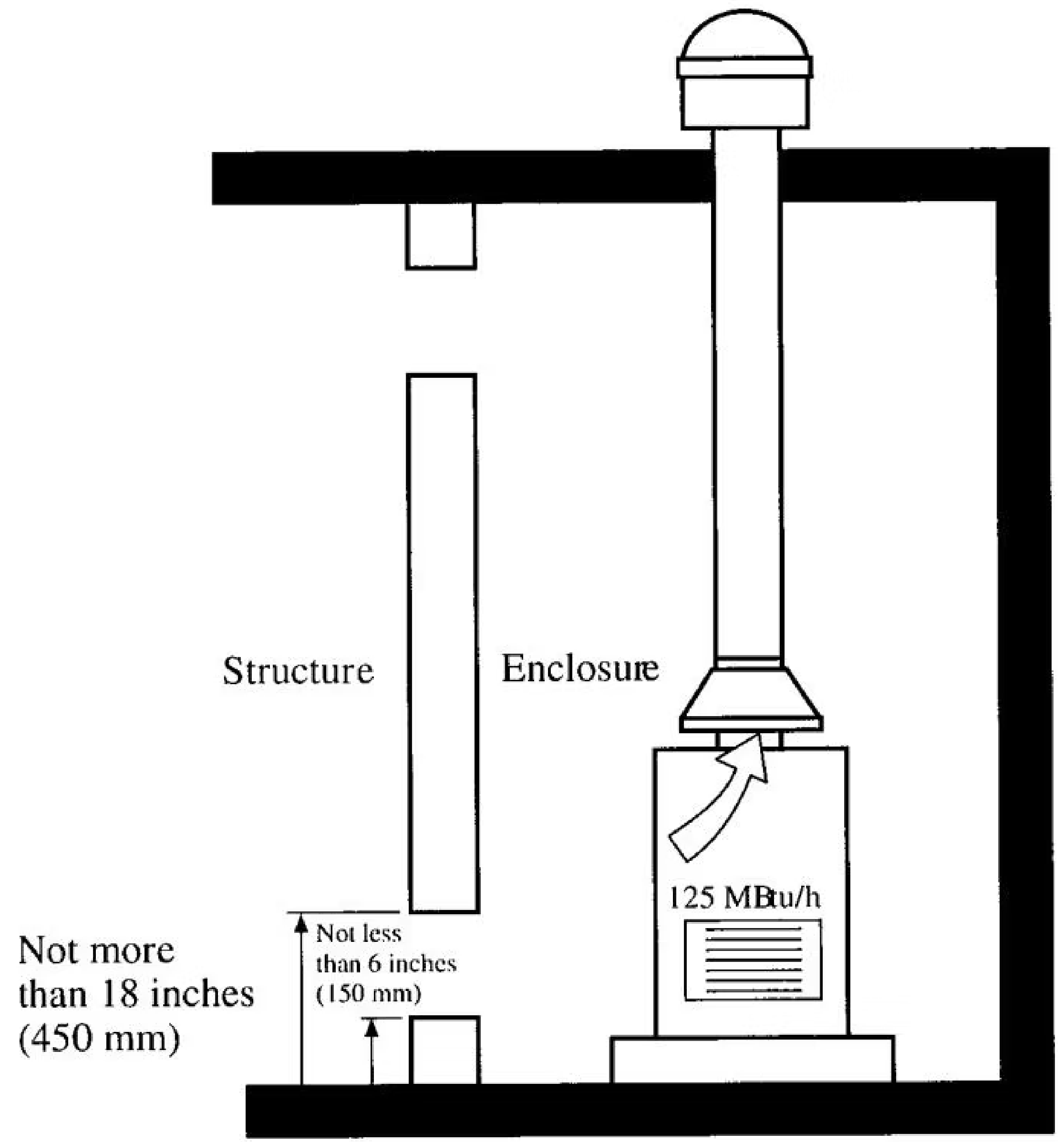
Round duct equivalent = 6 inches

Appliances in Enclosures

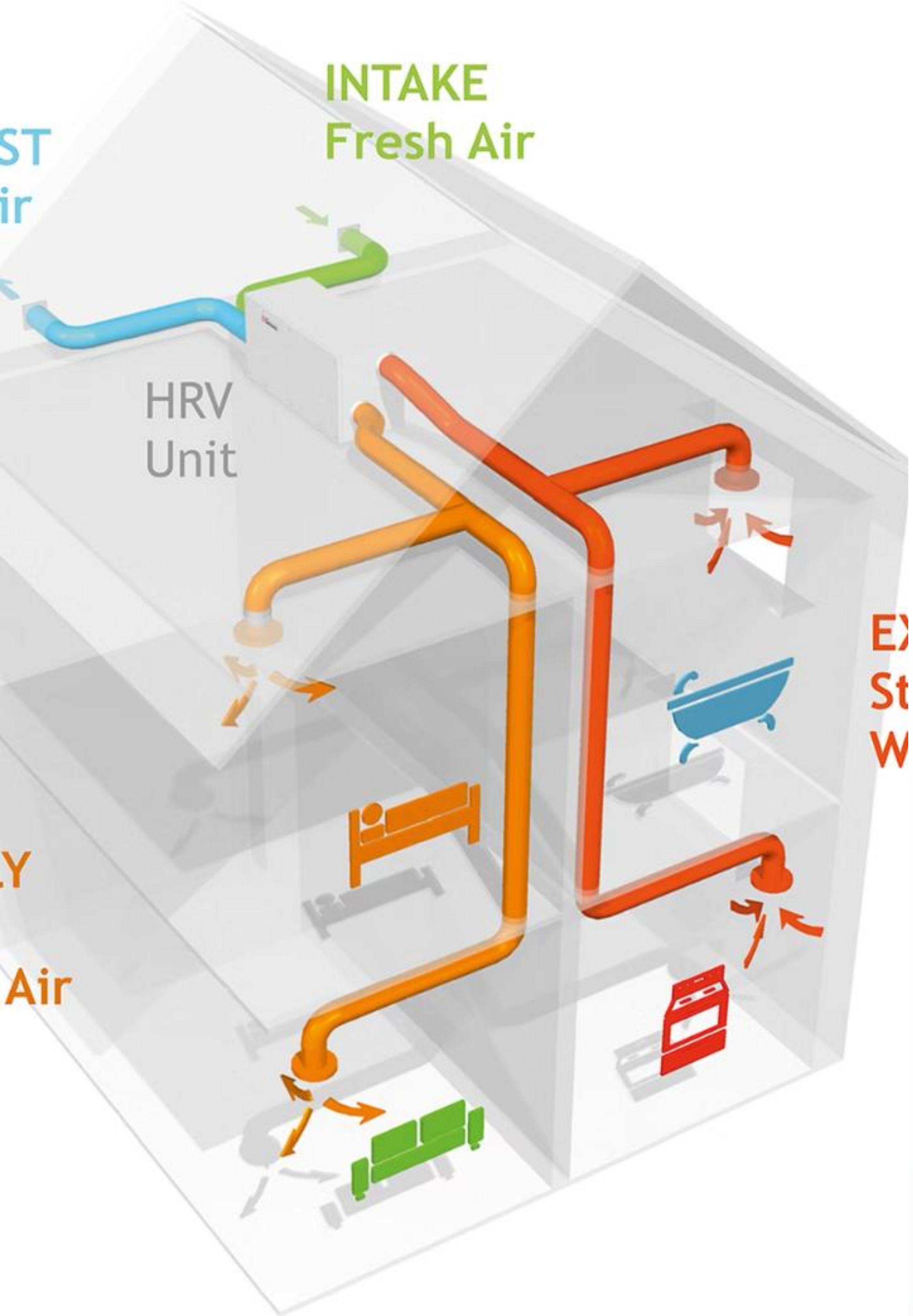
Using Building Volume

Where gas appliances are installed in an enclosure within the building Clause 8.2.6 of CSA B149.1 allows the entire volume of the structure to be used in the tables. This can avoid the need for an outside air supply if the structure large enough.

To take advantage of this, openings must be provided in the partition separating the enclosure from the building.



Non-airtight buildings with appliances located in an enclosure.



Calculating Enclosure Openings

Calculate Free Area

Free area required by Code is 1 square inch per 1,000 Btu/h

For 125 MBtu/h, the required free area is 125 square inches

Locate the opening between 6 and 18 inches (150 and 450 mm) above floor level

Add Ventilation Opening

For appliances with draft control devices, an additional opening of the same size is required

Locate this opening as close to the ceiling as practical

Always position above the relief opening of the draft control device

Ensure Proper Function

The upper opening is required to ventilate the room

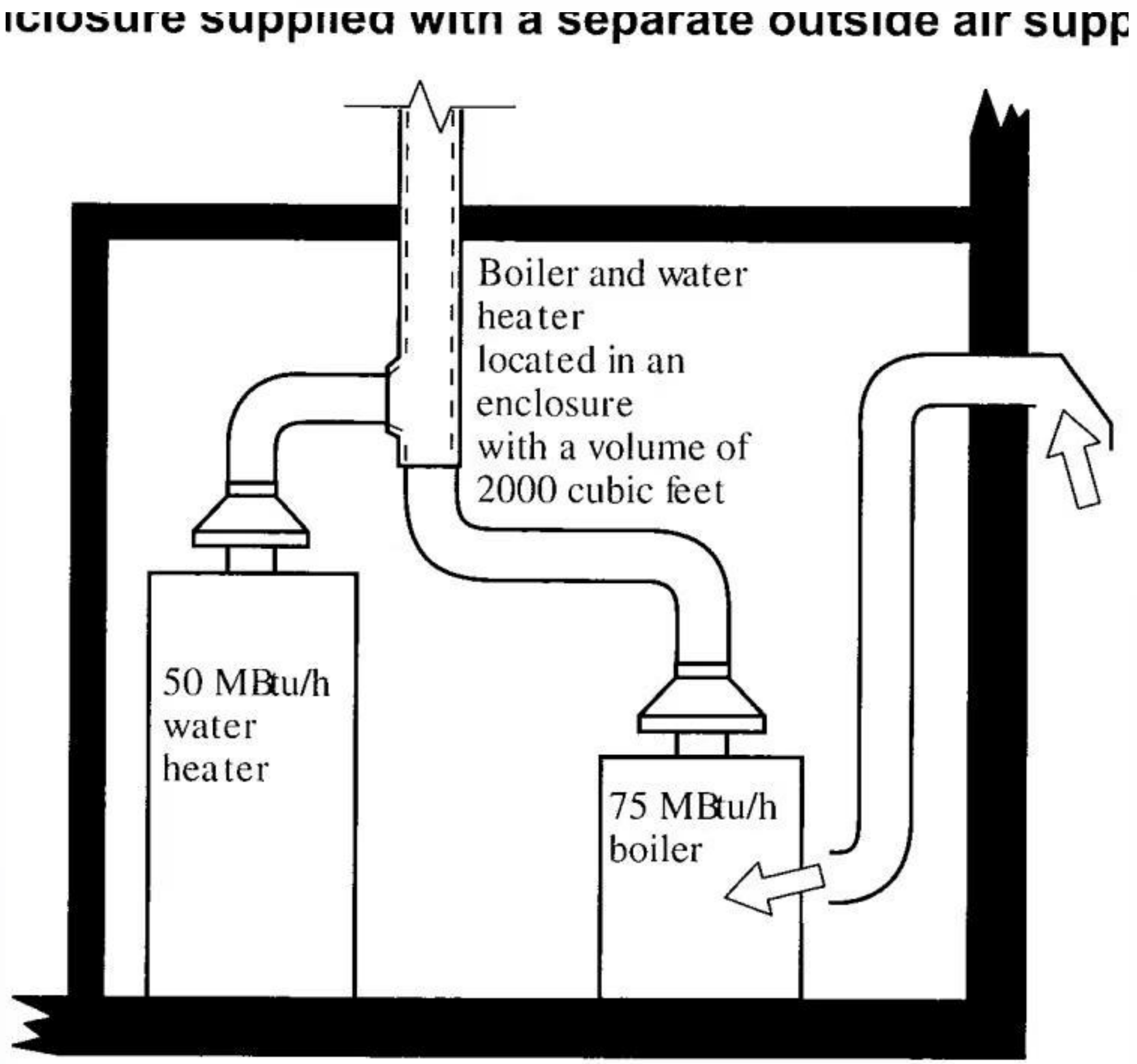
Prevents heat build-up that could affect the safe operation of the draft control device

Enclosures Without Openings

Special Considerations

Conditions such as excessive dust in a building can impair an appliance's performance, for this reason, the appliance or appliances have been placed in an enclosure within the building.

In this case, or in the case of enclosed appliances within very small structure, ventilation holes are not practical. A separate outside air supply must be supplied.



Enclosure supplied with a separate outside air supply.

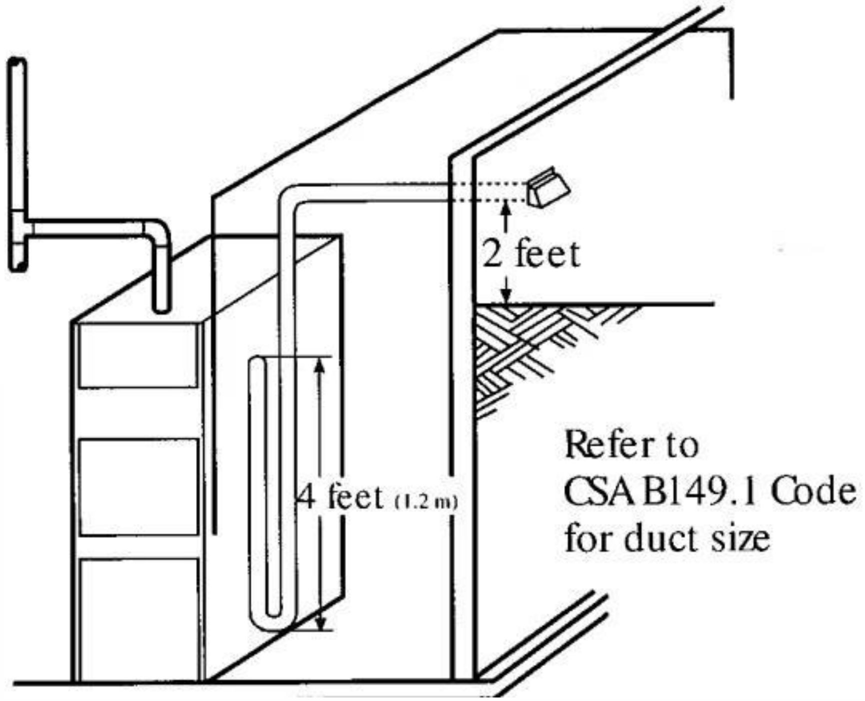
For a volume of 2,000 cu ft and a combined input of 125 MBtu/h, the required air supply opening is 18 square inches.

Cold Climate Considerations

Insulation Requirements

In cold climates, the gas technician/fitter will consider providing an outside air supply duct with insulation and a vapor barrier to minimize condensation on the outside surface of the duct.

If cold air becomes a comfort problem, certified automatic and interlocked dampers are also available, which only open when the appliances are operating.



Saskatchewan's acceptable method of installing combustion air supply to gas-fired appliances under 400 MBtu/h (120 kW).

Some jurisdictions encourage the use of a "P" trap in the air supply duct to inhibit the flow of heated air out of the air supply duct when the combustion equipment is not firing. Other jurisdictions may not accept this method.

Air Requirements for Equipment > 400 MBtu/h

Code Requirements

Air requirements for installations of over 400 MBtu/h (120 kW) are covered by Clause 8.4 of CSA B149.1. The air requirements fall into two categories: ventilation air and combustion air supply.

Ventilation Air

Ventilation air openings are supplied to an enclosure containing gas-fired appliances to allow free circulation of air. This permits excess heat or combustion products spilled at the draft-hood to ventilate to the outdoors through natural convection.

The Code specifies the height and the area of the ventilation opening or ducting. Whether you have an opening or ducting to the outdoors depends on the structure of the building.

Ventilation Air Requirements

> Ventilation of the space occupied by an appliance or equipment shall be provided by an opening for ventilation air at the highest practicable point communicating with the outdoors, and this opening shall not terminate within 12 in (300 mm) of any combustion air opening. The total cross-sectional area of such an opening shall be at least 10% of the area required in Clauses 8.4.2 and 8.4.3, but in no case shall the cross-sectional area be less than 10 in^2 (6,500 mm^2).

This requirement from Clause 8.4.1 ensures proper ventilation of spaces containing large gas appliances, preventing the buildup of heat and combustion products.

Combustion Air Supply Categories

Natural Draft Burners

Require air supply at a ratio of 30:1

Fan-Assisted Burners

Also require air supply at a ratio of 30:1

Blower Incorporation

Power burners incorporate blowers that draw sufficient air

Power Burners

Require air supply at a ratio of 15:1

Understanding this division is important because equipment with a draft control device requires air supply at a ratio of 30:1. Equipment with no draft control requires air supply at a ratio of 15:1. And power burners that incorporate a blower that can draw enough air into the burner to provide all air required for combustion and still have the pressure to overcome the resistance of the burner and appliance.

Natural Draft or Fan-Assist Burners

> When the air supply is provided by natural airflow from the outdoors for natural-draft, partial fan-assisted, fan-assisted, or power draft-assisted burners, there shall be a permanent air-supply opening having a cross-sectional area of not less than 1 in^2/7,000 Btu/h (310 mm^2/kW) up to and including 1,000,000 Btu/h (300 kW), plus 1 in^2/14,000 Btu/h (155 mm^2/KW) in excess of 1,000,000 Btu/h (300 kW).

This opening shall be either located at or ducted to a point not more than 18 in (450 mm) or less than 6 in (150 mm) above the floor level. This air-supply opening requirement shall be in addition to the opening for ventilation air required in Clause 8.4.1.

Appliance with Draft Control Device

Calculation Example

According to Clause 8.4.2, for a 700 MBtu/h boiler, the required free area = 700,000/7,000 = 100 square inches.

Approximate equivalent round duct diameter = 12 inches.

According to Clause 8.4.1, a ventilation opening no less than 10% of that calculated under Clause 8.4.2 is required, or a minimum of 10 square inches.

100 x 0.10 = 10 square inches.

Approximate equivalent round duct diameter = 4 inches.

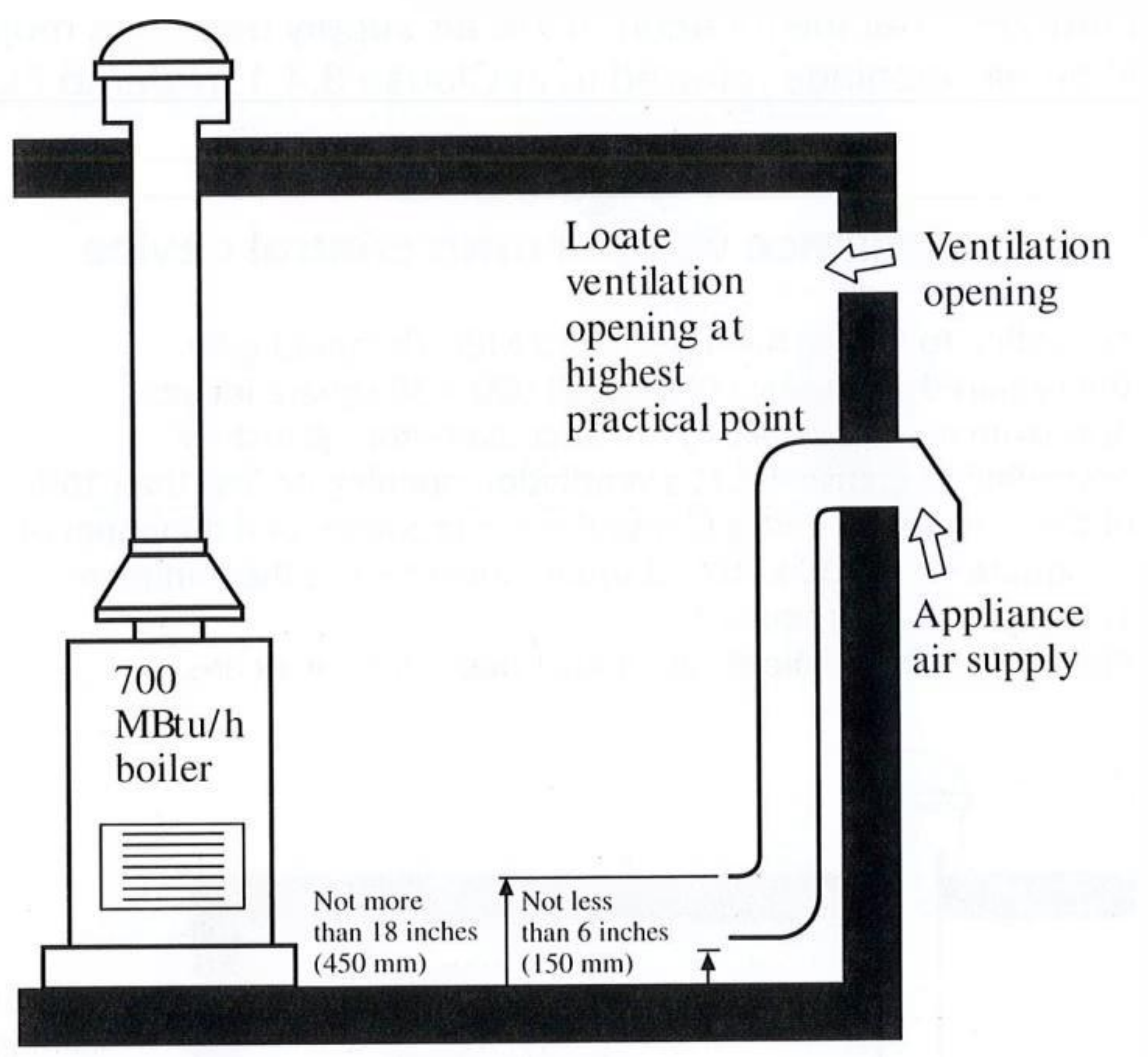


Diagram showing appliance with draft control device and required air openings.

Example 5: Large Appliances with Draft Control

Scenario

A mechanical room is equipped with gas appliances with a total combined input of 1600 MBtu/h. All appliances are equipped with draft control devices.

Calculation

Total input = 1,600 MBtu/h

First 1,000,000 Btu/h requires 1 square inch per 7,000 Btu/h

1,000,000 ÷ 7,000 = 142.85 square inches

Additional input in excess of 1,000,000 requires 1 square inch per 14,000 Btu/h

600,000 ÷ 14,000 = 42.85 square inches

Result

Total requirements are 142.85 + 42.85 = 186 square inches

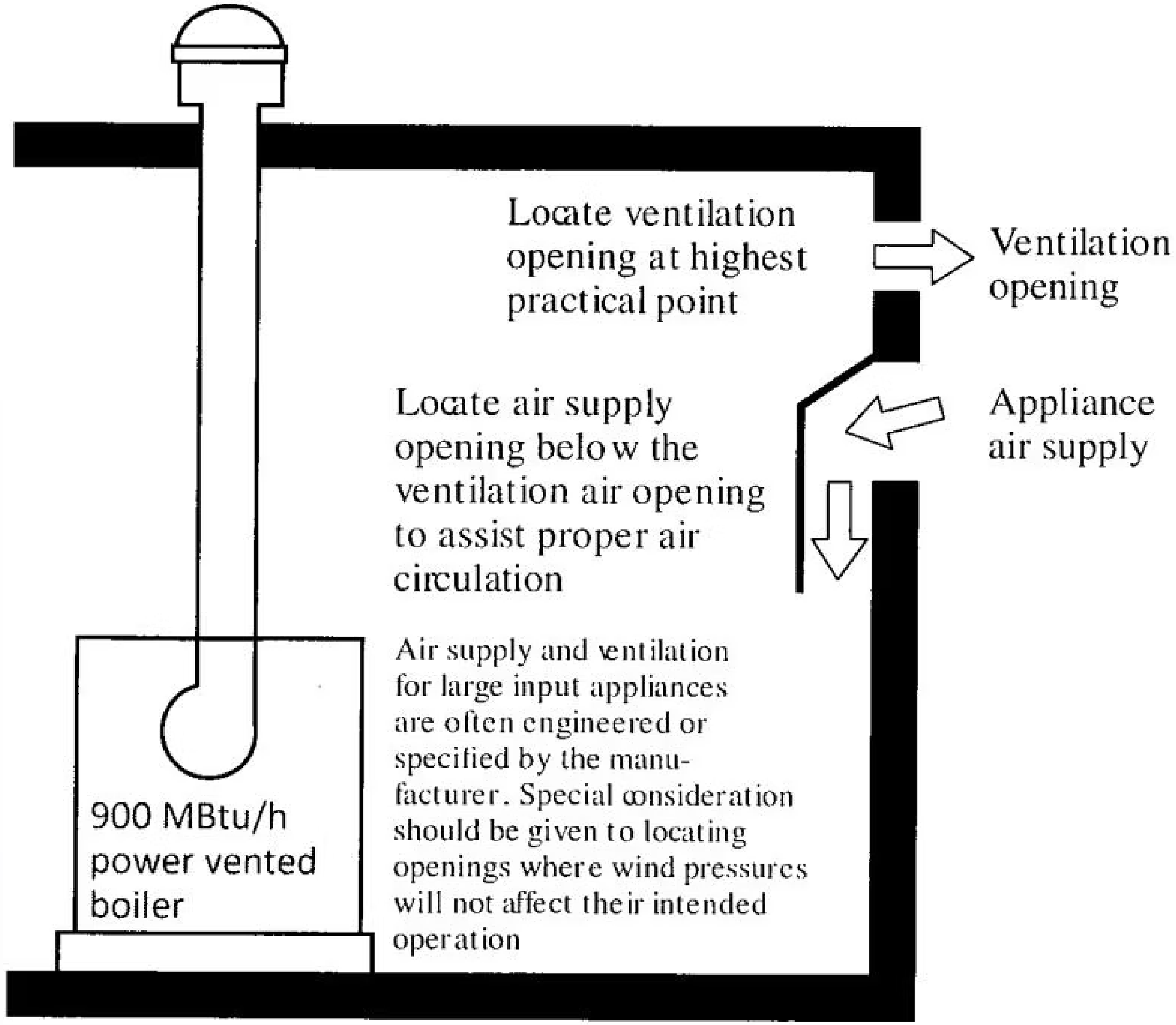
Ventilation opening requires 10% of air supply = 18.6 (19) square inches

Power Burners

Code Requirements

For equipment with a power burner, Clause 8.4.3 requires a permanent air supply opening having a minimum cross-sectional area of one square inch per 30 MBtu/h (70 mm^2/kW) of burner input.

Here too, the Code requires that the location of the air supply openings must not interfere with the needs of the ventilation air openings referred to in Clause 8.4.1.



Appliance without draft control device.

According to Clause 8.4.3, for a 900 MBtu/h input boiler, the required free area = 900,000/30,000 = 30 square inches. Approximate equivalent round duct diameter = 6 inches.

Example 6: Power Burner Appliances

Scenario

A structure is equipped with appliances rated at 1,500 MBtu/h. None of the appliances is equipped with draft control devices.

Calculation

Total input = 1,500 MBtu/h

Each 30,000 Btu/h requires 1 square inch

1,500,000 ÷ 30,000 = 50 square inches

Result

Free area of air supply = 50 square inches

Ventilation opening requires 10% of air supply or 10 square inches, whichever is greater = 10 square inches

Mixed Burner Types in Large Installations

For structures containing both natural draft or fan assisted burners and power burners, Clause 8.4.4 prescribes that the cross-sectional area of the opening(s) be at least the total area required for both types.

In other words, calculate the requirements for equipment falling under Clause 8.4.2 and add these to the requirements for equipment under Clause 8.4.3 to find the total requirements needed under Clause 8.4. Again, such requirement(s) must be in addition to the air opening for ventilation air.

Calculate Separately

Determine requirements for each burner type

Add Requirements

Combine the calculated areas

Include Ventilation

Add ventilation opening requirements

Proper Installation

Ensure all openings meet code requirements

Example 7: Mixed Large Appliance Types

Scenario

A structure has a mechanical room into which air must be ducted from outdoors. It contains the following appliances:

1. A boiler rated at 1200 MBtu/h, equipped with a barometric damper
2. Two duct heaters without draft controls rated at 600 MBtu/h each
3. Two hot water heaters rated at 300 MBtu/h each. Both heaters are equipped with draft-hoods

Calculation

Total input of appliances with draft control = 1,800 MBtu/h

Total input of appliances without draft control = 1,200 MBtu/h

First 1,000 MBtu/h with draft control requires 1 square inch per 7 MBtu/h

1,000 ÷ 7 = 142.8 square inches

Input in excess of 1000 MBtu/h with draft control requires 800 MBtu/h

1 square inch is required for each 14 MBtu/h in excess of 1,000 MBtu/h

800 ÷ 14 = 57.2 square inches

Final Calculation

1 square inch is required for each 30 MBtu/h of appliances without draft control

1,200 ÷ 30 = 40 square inches

Total requirements: 142.8 + 57.2 + 40.0 = 240.0 square inches

Free area of supply = 240 square inches

Ventilation opening requires 10% of air supply = 24 square inches

Ensuring Proper Air Supply: Key Takeaways

Safety First

Adequate air supply prevents dangerous conditions

Efficiency

Proper air supply ensures optimal appliance performance

Code Compliance

Follow CSA B149.1 requirements for all installations

Building Assessment

Evaluate construction type and air tightness

Appliance Evaluation

Consider appliance type and draft control configuration

Professional Responsibilities

Proper Assessment

Accurately evaluate building construction and appliance requirements

Correct Calculations

Use appropriate tables and formulas to determine air supply needs

Quality Installation

Install air supply systems according to code requirements

Client Education

Inform building owners about the importance of proper air supply

Safety Verification

Ensure all installations operate safely under all conditions

Regional Considerations

Climate Variations

Different regions of Canada experience vastly different climate conditions, which can affect air supply requirements and installation methods.

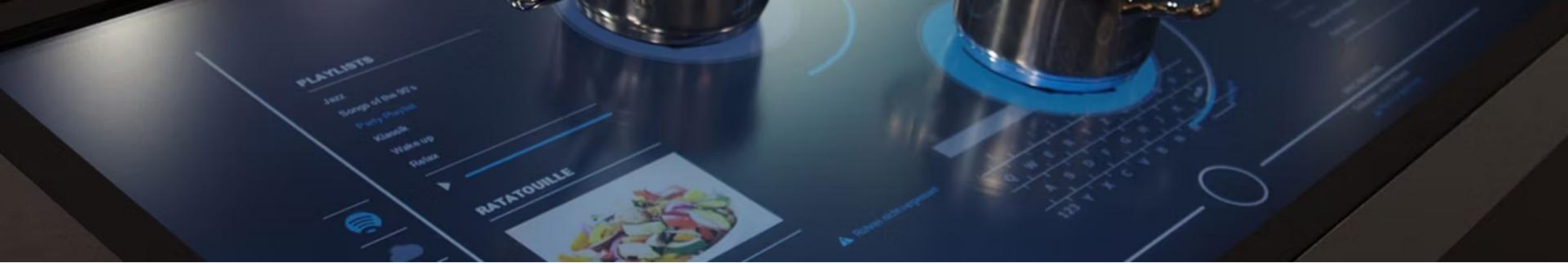
Cold climate regions may require additional considerations for insulation and condensation prevention on air supply ducts.

Local Code Amendments

Many jurisdictions have specific amendments to the national code that address local conditions and concerns.

Always check with local authorities having jurisdiction for specific requirements that may differ from the national standard.

Some regions have specific approved methods for air supply installations, such as Saskatchewan's P-trap configuration for combustion air supply.



Future Trends in Air Supply Systems

Higher Efficiency Appliances

Continued development of appliances with lower air requirements

More Sealed Combustion

Increased adoption of direct vent systems

Smart Ventilation

Integration with building automation systems

Tighter Building Envelopes

More sophisticated air supply solutions needed

As building codes continue to evolve toward more energy-efficient structures, the requirements for combustion air supply will likely become more sophisticated. Gas technicians must stay current with changing technologies and regulations.

Summary: Combustion Air Supply

Assess Building

Determine if building is airtight or non-airtight

Identify Appliances

Determine if appliances have draft control devices

Calculate Requirements

Use appropriate CSA B149.1 tables

Install Properly

Follow code requirements for sizing and placement

The gas technician/fitter must distinguish between airtight buildings and install an air supply that will ensure the appliance operates safely and efficiently. By following the guidelines in CSA B149.1 and understanding the principles of combustion air requirements, technicians can ensure safe and efficient operation of gas appliances in all types of buildings.