

B149.1HB-00



Natural Gas and Propane Installation Code Handbook



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Preface

This is the third edition of CSA International's B149.1HB, *Natural Gas and Propane Installation Code Handbook*. It supersedes the previous editions, published in 1995 and 1991 by the Canadian Gas Association.

In 1991, members of the natural gas and propane industry recommended to the Canadian Gas Association that an appliance installation Code handbook be written. This recommendation included a suggestion that the handbook provide clarification of Code requirements for its users. It has been recognized that regulatory documents, such as the Code, contain technical language conveying both legal and field-usage requirements, but that the effect of such language may diminish the information communicated.

This handbook serves as a means of improving the communication of Code requirements. The committee members who develop the Code have had experience with most of the information contained in this handbook, and this experience has served to facilitate their work. The contents of the handbook were derived primarily from submissions to the CSA B149 Installation Code Committee received from a variety of sources. Much of the background information for this handbook, therefore, originated from these requests for changes to the requirements of the Code. The background information provided with a proposal for a change to the Code will often be used in future editions of this handbook; hence, it is important that the intent and rationale for any proposal be clear.

CSA International especially acknowledges the contribution of Ted Kesik and Knowledge Mapping Inc. to the development of this publication.

Comments and suggestions for improving future editions of the handbook should be addressed to:

Secretary of CSA B149 Installation Code Committee
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January 2000

HOW TO USE THIS HANDBOOK

This handbook is solely intended for use as a companion document to CSA B149.1-00, *Natural Gas and Propane Installation Code*. While every attempt has been made to provide accurate and relevant materials, always keep in mind that this handbook is not a substitute for the Code. There are Code requirements that are not found in this handbook. These requirements fall under the specific regulations enforced by the authority having jurisdiction in your area, and must be observed. Keep up to date on the Code requirements in your area and always consult with the authority having jurisdiction for approval of unusual or unfamiliar installations not covered by the Code.

The handbook follows the sequence of the Code from *1. Scope* to *7. Venting Systems and Air Supply for Appliances*, inclusive. Materials have been developed to help users understand, interpret, and apply the Code requirements, and they are outlined in the pages that follow.

Users of this handbook are encouraged to provide feedback on aspects of the Code that require further clarification, in the form of commentary, illustrations, or examples. Feedback may be directed to the address provided under the Preface to this handbook.

Key Points

- This handbook is a companion to, not a substitute for, the B149.1 Code.
- The materials contained in this handbook are purely explanatory and do not necessarily reflect approved requirements.
- Always check local regulations when performing unusual or unfamiliar installations.
- This is your industry's handbook – get involved and provide helpful feedback on areas you believe require clarification.

ABOUT THIS HANDBOOK

This handbook serves as a companion document to CSA B149.1, *Natural Gas and Propane Installation Code*. As such, it does not address all of the Code requirements, particularly where these are considered self-explanatory. It contains information that is useful to natural gas and propane appliance installers, regulatory authorities, and anyone interested in understanding current practices for natural gas and propane appliance installations. The contents of this handbook include

- extracts of commonly referenced Code text, tables and figures;
- intent and rationale statements of Code requirements commonly requiring interpretation in the field;
- notes providing practical insights into Code-related items;
- commentary, including text and figures, explaining fundamental principles of appliance installations;
- illustrations of Code requirements;
- tables providing useful information from referenced documents;
- examples of how to apply Code requirements;
- cross-referencing to link associated requirements of different parts of the Code (looking ahead and looking back notes); and
- better practice notes, providing suggestions for exceeding current installation requirements.

The section that follows provides an explanation of the organization of the handbook.

EXPLANATION OF HANDBOOK NOTATION

A number of methods are used throughout the handbook to assist Code users in understanding, interpreting, and applying Code requirements. They are illustrated and described below.

NOTE: The Δ symbol indicates major changes or additions to the previous edition of the Code.
Inclusion of Code Text, Tables, and Figures

Code text, tables, and figures have been reproduced when detailed explanation or convenient reference is required.

Code text, where provided, does not appear in a bordered frame and has been reproduced verbatim. Code users should always check if the wording of the regulations from the authority having jurisdiction differs from that contained in this handbook.

(**Note:** In some cases, typographical errors in the Code may have been corrected in this handbook.)

IMPORTANT NOTE

Unlike previous editions of the B149.1 Code, all Code requirements are now referred to as Clauses. The differences in the method of listing requirements between the current edition and previous editions are shown below:

Current Edition of B149.1	Past Editions of B149 Codes
Clause #	PART #
Clause #.#	Section #.#
Clause #.#.#	Clause #.#.#
Item (a)	SubClause (a)
Item (i)	SubSubClause (i)

Code tables and figures appear in frames with a single outline, as shown in the example below:

Table 5.8.3 Spacing of Supports for Piping	
NPS	Maximum Spacing of Supports ft (m)
1/2 or less — horizontal	6 (2)
3/4 – 1 — horizontal	8 (2.5)
1-1/4 – 2-1/2 — horizontal	10 (3)
3 – 4 — horizontal	15 (5)
5 – 8 — horizontal	20 (6)
10 or larger — horizontal	25 (8)
1-1/4 or larger — vertical	Every floor but not more than 125% of horizontal spacings
Tubing – all sizes – vertical and horizontal	6 (2)

Intent and Rationale Statements

Intent and Rationale

The intent is a concise explanation of the reason for a Code requirement, sometimes best described as the common sense reason for the requirement.

The rationale for a requirement represents the technical basis for the requirement, and an explanation of the selection of specific values of measurement, or the prescription of specific practices. As better scientific and engineering data becomes available, the rationale, and possibly the requirement, may be revised to reflect improved understanding. The advantage of cataloguing rationales is that "rule of thumb" approaches are clearly separated from engineered requirements, so that future research and development may be more effectively targeted. All intent and rationale statements are identified and are contained within a box with a single outline.

There are two types of intent and rationale statements provided in this handbook — general and specific.

General intent and rationale statements are provided for each section forming Clauses 1 through 7, inclusive, of the B149.1 Code. In many cases, it is noted that the rationale is conveyed within the requirements themselves.

Specific intent and rationale statements have been developed where particular Code requirements have been identified as commonly requiring interpretation. These have been developed by integrating reasons from Code committee meeting minutes and working with a diverse group of expert Code users to provide practical insight. Where it is useful, the actual Code wording has been included to make review convenient.

Intent and rationale statements are not official or legally binding. Instead, they are provided to improve insight into Code requirements.

Handbook Notes and Commentary

Notes and commentary have been developed to provide additional useful information. Notes appear as text in boxes with a single outline, and commentary, including text and figures, appears in boxes with double outlines.

NOTES

Note text may include materials taken verbatim from the Appendices of the Code, practical insights, excerpts from referenced standards, general explanatory material, or "how to" advice on ways to meet Code requirements.

COMMENTARY

Commentary includes both text and figures. Commentary frames are intended to

- simplify or clarify Code use;
- provide fundamental principles; and
- clearly illustrate important concepts.

Commentary frames provide information that makes the Code easier to understand and apply.

Handbook Illustrations, Tables, and Examples

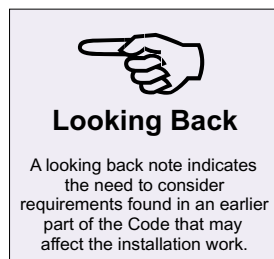
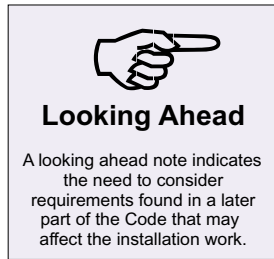
Handbook illustrations, tables, and examples are contained in boxes with double outlines, as shown below:

Title of Illustration, Table, or Example

- Handbook illustrations are intended to visually summarize Code requirements.
- Tables summarize useful information not found in the Code.
- Examples are designed to explain typical applications of Code requirements.
- Illustrations and examples should only be used as a guideline in practice, as these may not represent the actual requirements of the authority having jurisdiction in your area.

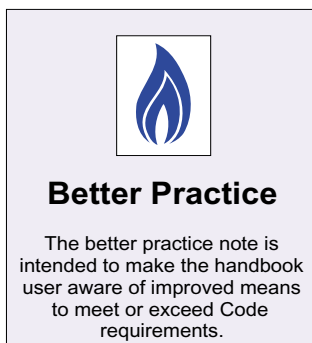
Looking Ahead, Looking Back, and Better Practice Notes

Helpful notes have been developed to assist Handbook users with related Code requirements that apply to a particular requirement under consideration. These point the reader ahead or back, as applicable.



contents of this handbook will reduce the need to require official interpretations and that questions of interpretation may be resolved through consultation and consideration of the fundamental principles, intent, and rationale underlying Code requirements as presented in this document.

Better practice notes that reflect improved means to meet or exceed Code requirements have also been developed. These have been developed on the basis of experience and are only intended to serve as suggestions. The appearance of the gas flame symbol (see the better practice note example below) identifies better practice, and not a Code



requirement.

Finding Handbook Materials

To find handbook materials, users may simply turn to the part or section of the handbook corresponding to the Code requirement needing clarification or interpretation.

Obtaining Specific Interpretations

Due to the limited nature and scope of this handbook, official interpretations of Code requirements have not been developed. These can only be applied for through the authority having jurisdiction. It is hoped that the explanatory

1. SCOPE

The scope of this handbook is limited to Clauses 1 through 7, inclusive, of CSA B149.1-00, *Natural Gas and Propane Installation Code*. These sections represent the requirements governing most typical appliance installations encountered by natural gas and propane contractors.

Due to the differences in the physical nature of natural gas and propane, separate requirements are indicated in the Code. These differences should not lead to confusion in practice.

However, for installers, the majority of the requirements in Clauses 1 through 7, except for those relating to pressure controls and pipe sizing, are common to natural gas and propane. Due to the existence of fuel-specific differences, the applicable *1. Scope* requirements have been replaced with a commentary that outlines the scope of this handbook as it applies to natural gas and propane appliance installations in simple and practical terms.

Refer to *How to Use This Handbook* for further information.

Key Points

- *1. Scope* identifies items to which the handbook contents apply.
- Differences between requirements for natural gas and propane are significant and should be taken into account.
- This handbook covers Clauses 1 through 7, inclusive, of B149.1, *Natural Gas and Propane Installation Code*.

1. SCOPE — B149.1 CODE HANDBOOK

The scope of this handbook is confined to the installation of typical appliances, equipment, components, and accessories where gas is to be used for fuel purposes, and to the installation of piping and tubing systems extending from the termination of the utility installation (in the case of natural gas) or from the termination of the second stage regulator (in the case of propane).

In practical terms, this handbook explains

- important Code definitions;
- general requirements for all installations;
- pressure controls;
- piping and tubing systems, hose, and fittings;
- specific types of appliance installations; and
- venting systems and air supply for appliances.

Where the term "gas" is used, it is intended to apply equally to and include any of the following gases or mixtures of them: natural gas, manufactured gas, propane, or mixtures of propane and air.

Where the term "natural gas" is used, it is intended to apply only to natural gas (methane).

Where the term "propane" is used, it is intended to apply specifically to and include any material that is composed predominantly of any of the following hydrocarbons or mixtures of them: propane, propylene, butanes (normal butane or isobutane), and butylenes.

It should be carefully noted that the applicable portions of all reference publications also fall within the scope of the B149.1 requirements. Since it is often impractical to obtain these reference documents in the field, they have been summarized within the commentary sections of this handbook, where possible.



Looking Ahead

To best determine whether a specific installation falls under the B149.1 Code, review the parts that follow.

If it cannot be clearly determined, consult the regulatory authority for assistance.

2. DEFINITIONS, ABBREVIATIONS, AND REFERENCE PUBLICATIONS

This chapter of the handbook explains the definitions, abbreviations, and reference publications pertaining to the B149.1 Code.

Definitions appear throughout the Code as bold-faced, italicized text (*definition*). These terms should be clearly understood when applying or interpreting the Code, and should not be confused with definitions cited in other codes or standards, dictionaries, manufacturers' terminology, or trade slang. Industry and regulatory agencies should attempt to apply these definitions consistently in practice.

The abbreviations used in the Code refer to organizations and to words and phrases that are listed in Clause 2.2.

The reference publications listed in Clause 2.3 refer to codes or standards governing equipment, components, methods, or materials cited in the Code. It is important to ensure that the correct version of these standards is used when referencing specific information related to the application or interpretation of the Code.

Key Points

- Definitions provide legal descriptions of the terms used in the Code and should be applied and interpreted consistently.
- Abbreviations refer to organizations involved in related codes and standards activities, and to technical words or phrases used in the natural gas and propane industries.
- Reference publications refer to applicable codes and standards applied to equipment, components, methods, and materials cited in the B149.1 Code.

2. DEFINITIONS, ABBREVIATIONS, AND REFERENCE PUBLICATIONS

2.1 Definitions

It is important to interpret and apply the following definitions consistently. They are supplied with appropriate commentary in order to clarify their intended and/or practical usage. Illustrations have also been provided where necessary.

Accessory — a part capable of performing an independent function(s) and contributing to the operation of the **appliance(s)** that it serves.

An example of an *accessory* is a thermostat. The thermostat is capable of independent operation, and it contributes to the operation of the appliance by controlling its on-off cycle.

Air supply — (with respect to the installation of an **appliance**) **combustion air**, **excess air**, **flue gas dilution air**, **primary air**, **secondary air**, and **ventilation air**.

Combustion air — the air required for satisfactory combustion of gas, including **excess air**.

Excess air — that portion of the **combustion air** that is supplied to the combustion zone in excess of that which is theoretically required for complete combustion.

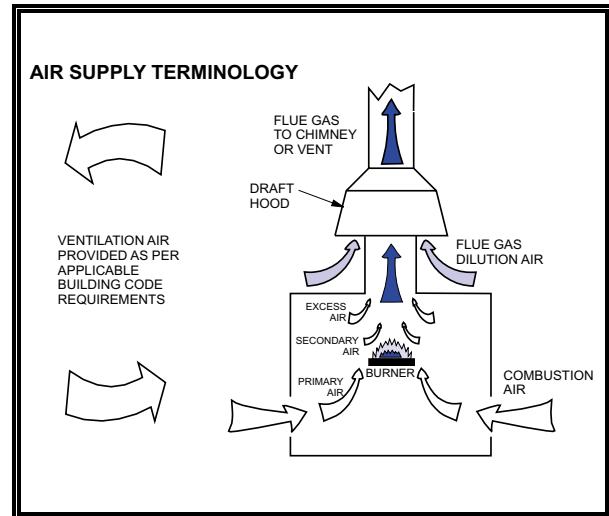
Flue gas dilution air — the ambient air that is admitted to a **venting system** at the **draft hood**, **draft diverter**, or **draft regulator**.

Primary air — that portion of the **combustion air** that is supplied for the initial stages of the combustion process and is supplied upstream from the point of **ignition**.

Secondary air — that portion of the **combustion air** that is supplied for the intermediate and final stages of the

combustion process and is supplied downstream from the point of **ignition**.

Ventilation air — air that is admitted to a space containing an **appliance** to replace air exhausted through a **ventilation** opening or by means of exfiltration.



Appliance — a device to convert gas into energy that includes any **component**, control, wiring, piping, or tubing required to be part of the device.

Category I Appliance — an appliance that operates with a nonpositive vent static pressure and with a flue loss not less than 17%.

Note: This category consists of draft hood equipped appliances, appliances labelled as Category I, and fan-assisted appliances for venting into Type B vents.

Category II Appliance — an appliance that operates with a nonpositive vent static pressure and with a flue loss less than 17%.

Category III Appliance — an appliance that operates with a positive vent static pressure and with a flue loss not less than 17%.

Category IV Appliance — an appliance that operates with a positive vent static pressure and with a flue loss less than 17%.

An example of an *appliance* is a boiler, complete with all controls, electrical power, and control wiring, supplied as a certified unit. It does not include the venting system and air supply (unless it is a direct vent appliance) or the gas piping or tubing that supplies the unit, or the remainder of the appliances in the building.

Approved — acceptable to the *authority having jurisdiction*

The term *approved* is used to define a method, practice, or material that is acceptable to the authority having jurisdiction. By allowing the use of approved alternatives, the B149.1 Installation Code permits greater flexibility in its application by enabling the authority having jurisdiction to exercise judgment, often based on past experience, to permit or restrict a particular method, practice, or material. It remains the responsibility of the installer to obtain approval for methods, practices, or materials that are not cited in the B149.1 Code.

Authority having jurisdiction — the governmental body responsible for the enforcement of any part of this Code or the official or agency designated by that body to exercise such a function.

The *authority having jurisdiction* in the case of the B149.1 Code refers to the inspection authorities listed under the Interprovincial Gas Advisory Council. It should be noted, however, that in the course of installing gas and propane appliances, areas of the work may fall under the jurisdiction of another authority. For example, where plumbing or fire separations are involved, building code authorities may have jurisdiction. Where electrical safety is involved, a utility or other regulatory authority may have jurisdiction. There may even be cases, such as the installation of incinerators, where an environmental regulatory authority

may have jurisdiction. It is important to become familiar with the various authorities having jurisdiction over every aspect of the work involved in any particular installation.

Automatic vent damper device — a device intended for installation at the outlet or downstream of an individual *appliance draft hood* and designed to automatically open the *venting system* before or shortly after the main *burner* is activated and to automatically close the *venting system* after the main *burner* is deactivated.

Electrically operated — an *automatic vent damper device* that employs electrical energy to control the device.

Thermally actuated — an *automatic vent damper device* dependent for operation exclusively upon the direct conversion of the thermal energy of the *vent* gases into mechanical energy.

Baffle — a stationary device used to divert the flow of fluid (air, water, or steam) and *flue gases* (*flue baffle*) or to shield parts of an *appliance* from the effects of flame (flame *baffle*) or heat (*heat baffle*).

Bathroom — a room used primarily for bathing and containing a bathtub and/or shower.

Bedroom — a room furnished with a bed and used primarily for sleeping.

Bed-sitting room — a one-room apartment serving as both a *bedroom* and a sitting room.

Bleed vent — a vent where the expiration or inspiration of air or gas occurs from or to one side of a diaphragm of any *accessory, component, or equipment* such as a *valve, pressure regulator, or switch*.

Boiler — an *appliance* intended to supply hot liquid or vapour for space heating processing or power purposes.

Branch line — the part of a piping or tubing system that conveys gas from the main piping or tubing or header to an *appliance* or *appliances*.

Building — a *structure* or part thereof used or intended for supporting or sheltering persons, animals, or property and classified by its occupancy in accordance with the applicable building code of the *authority having jurisdiction* or, in the absence of such, in accordance with the *National Building Code of Canada*.

Aircraft hangar — a *building* or other *structure* in any part of which aircraft are housed or stored and in which aircraft may be undergoing servicing, repairs, or alterations.

Assembly building — any *building* or part thereof used by a gathering of persons for civic, political, travel, religious, social, educational, recreational, or like purpose, or for the consumption of food or drink.

- Δ **Care or detention occupancy building** — any *building* the occupancy or use of which or any part thereof is by persons who require special care or treatment because of cognitive or physical limitations, or by persons who are incapable of self-preservation and who are restrained from self-destruction by security measures not under their control.

Commercial building — any *building* used in connection with direct trade with or service of the public.

Industrial building — any *building* used in connection with production or process work or with storage or warehousing.

- Δ **Residential building** — any *building* or part thereof used by persons for whom sleeping accommodation is provided but who are not harboured or detained to receive medical care or treatment or are not involuntarily detained.

The table provided below is based on Table 3.1.2.1 of the 1995 *National Building Code of Canada* (NBC), and may be used to identify the NBC classification and division for each B149.1 building definition.

B149.1 Building Definition	NBCC Group Classification	NBCC Division(s) Classification
Assembly	A	1,2, and 3
Commercial	D and E	N/A
Industrial	F	1,2, and 3
Care/detention occupancy	B	1 and 2
Dwelling Unit (Residential)	C	N/A

Building opening — a planned aperture that is intended to permit air infiltration but does not include an exhaust *vent* or a nonopenable window.

Burner — a device or group of devices that forms an integral unit for the introduction of gas, with or without air or oxygen, into the combustion zone for *ignition*.

Fan assisted — a *burner* in which the *combustion air* is supplied by a mechanical device such as a fan or blower at sufficient pressure to overcome the resistance of the *burner* only.

Forced draft — a *burner* in which the *combustion air* is supplied by a mechanical device such as a fan or blower at sufficient pressure to overcome the resistance of the *burner* and the *appliance*.

Natural draft — a *burner* that is not equipped with a mechanical device for supplying *combustion air*.

Certified — (with respect to any *appliance*, *accessory*, *component*, *equipment*, or manufacturer's installation instructions) investigated and identified by a designated testing organization as conforming to recognized standards, requirements, or accepted test reports.

The application of the term *certified* is confined to appliances, accessories, components, equipment, and manufacturer's installation instructions. It must not be confused with the term *approved*. Certification involves testing, rather than judgment, by a recognized testing organization. The testing is performed to recognized standards, or construction and performance requirements. Certification is generally acknowledged by a certification label.

Chimney — a primarily vertical shaft that encloses at least one *flue* for conducting *flue gases* outdoors.

Factory-built — a *chimney* that consists entirely of factory-made parts, each designed to be assembled with the other without requiring fabrication on site.

Masonry or concrete — a *chimney* of brick, stone, concrete, or *approved* masonry units constructed on site.

Metal (smokestack) — a single-wall *chimney* of metal constructed on site.

Chimney draft — see **Draft**.

Combustible — material that fails to conform to ULC Standard CAN4-S114.

Combustible liquid — a liquid that has a *flash point* at or above 100°F (38°C) and below 200°F (93°C).

Combustion air — see **Air supply**.

Combustion products — constituents that result from the combustion of gas with the oxygen of the air and include inert gases but exclude *excess air*.

Combustion safety control (flame safeguard) — a primary safety control that senses the presence of flame and causes gas to be shut off in the event of flame or *ignition* failure.

Commercial- and industrial-type appliance or equipment — an *appliance* or *equipment* other than a residential or recreational type.

Commercial building — see **Building**.

Commercial cooking appliance — an *appliance* that complies with the applicable CSA standard covering hotel and restaurant ranges and unit broilers, hotel and restaurant deep fat fryers, commercial baking and roasting ovens, counter *appliances*, kettles, steam cookers, or steam generators.

Component — an essential part of an *appliance* or *equipment*.

An example of a *component* is the burner of a boiler. Other components include the controls and valves.

Concealed piping or tubing — piping or tubing that, when in place in a wall, floor, or ceiling of a finished *building*, is hidden from view and can only be exposed by use of a tool. It does not apply to piping or tubing that passes directly through a wall or partition.

Concrete chimney — see **Chimney (masonry or concrete)**.

Condensate (condensation) — a liquid separated from a gas (including *flue gas*) due to a reduction in temperature or increase in pressure.

Connector — tubing or *hose* with a *fitting* at each end for connecting an *appliance* or *equipment* with piping or tubing.

Hose — a flexible assembled conduit not exceeding 6 ft (2 m) in length.

Metal — a corrugated or semirigid conduit made entirely of metal.

Container — (with respect to NGV/ propane storage) either a *cylinder* or a *tank*.

Continuous pilot — see **Pilot**.

Cylinder — (with respect to *NGV*/propane storage) a **container** designed and fabricated in accordance with the specifications of Transport Canada or the U.S. Department of Transportation for the storage and transportation of gas.

Cylinder system — an assembly that includes the **cylinder** base or bracket, **cylinder(s)**, **cylinder valve(s)**, **connector(s)**, manifold **valve** assembly, **regulator(s)**, and relief **valve**, or any combination of these.

Damper — a plate or **valve** for regulating the flow of air or **flue gas**.

Barometric — see **Draft regulator**.

Depressurization — the 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 may experience sustained depressurization of up to 0.02 in w.c. (5 Pa); for example, a tight structure with a mechanically ventilated structure. See Appendix C.

Direct-fired appliance — an **appliance** in which the **combustion products** or **flue gases** are intermixed with the medium being heated.

Direct vent appliance — an **appliance** constructed so that all the **combustion air** is supplied directly from, and the **products of combustion** are vented directly to, outdoors by independent enclosed passageways connected directly to the **appliance**.

Dirt pocket (dust pocket) — a pocket in a piping system designed for the collection of dirt and from which the dirt can be removed.

Draft — the flow of air or **combustion products**, or both, through an **appliance** and its **venting system**.

Chimney — the available **natural draft** of the **chimney** measured at or near the base of the **chimney**.

Forced — a **mechanical draft** produced by a

device upstream from the combustion zone of an **appliance**.

Induced — a **mechanical draft** produced by a device downstream from the combustion zone of an **appliance**.

Mechanical — a **draft** produced by a mechanical device, such as a fan, blower, or aspirator, that may supplement **natural draft**.

Natural — a **draft** other than a **mechanical draft**.

Draft control device — either a **draft hood** or **draft regulator**.

Draft hood — a **draft control device** having neither movable nor adjustable parts. A **draft hood** may be built into an **appliance**, attached to an **appliance**, or made part of a **vent connector**. It is designed to
(a) assure the ready escape of **flue gases** from the combustion chamber in the event of either no **draft** or stoppage downstream from the **draft hood**;

(b) prevent a backdraft from entering the combustion chamber of the **appliance**; and
(c) neutralize the effect of stack action of either a **chimney** or a **vent** upon the operation of the **appliance**.

Draft regulator (barometric damper) — a **draft control device** intended to stabilize the **natural draft** in an **appliance** by admitting room air to the **venting system**. A double-acting **draft regulator** is one whose balancing **damper** is free to move in either direction.

Drip pocket (drip) — a pocket in a piping system designed for the collection of condensate and from which the condensate can be removed.

Dust pocket — see **Dirt pocket**.

Dwelling unit — a housekeeping unit used or intended to be used as a domicile by one or more persons, and usually containing cooking, eating, living, sleeping, and sanitary facilities.

Enclosure — a secondary **structure** (room) within

or attached to a **structure (building)** in which an **appliance(s)** is installed.

Examples of an *enclosure* include a mechanical room within a building and a mechanical room attached to a building, including any roof-top enclosures.

Equipment — a device, other than an **appliance**, **accessory**, or **component**, that is connected to a piping or tubing system.

Examples of *equipment* are service meters and regulators. Other types of equipment are vapourizers, in the case of propane, and a compressor, in the case of natural gas.

Expanding pilot — see **Pilot**.

Factory-built chimney — see **Chimney**.

False ceiling space — ceiling space that is enclosed with tiles or panels that are removable without the use of a tool. A typical type is the T-bar-constructed suspended ceiling.

Fan-assisted burner — see **Burner**.

Fan-assisted combustion system — an appliance equipped with an integral mechanical means to either draw or force products of combustion through the combustion chamber and/or heat exchanger. See Appendix C.

FAN Max — the maximum appliance input rating of a **Category I appliance** with a fan-assisted combustion system that could be attached to the vent. See Appendix C.

FAN Min — the minimum appliance input rating of a **Category I appliance** with a fan-assisted combustion system that could be attached to the vent. See Appendix C.

FAN+FAN — the maximum combined input rating of two or more fan-assisted appliances attached to the common vent. See Appendix C.

FAN+NAT — the maximum combined input rating of one or more fan-assisted appliance and one or more draft-hood-equipped appliance attached to the common vent. See Appendix C.

Fast-closing valve — see **Valve**.

Fireplace — a device for burning solid fuel that has the major portion of one or more essentially vertical sides open or openable for refuelling and for the visual effects of the burning fuel.

Fitting — an item in a piping or tubing system that is used as a **connector**, such as an elbow, return bend, tee, union, bushing, coupling, cross, or nipple, but does not include such functioning items as a **valve** or **pressure regulator**.

Flame safeguard — see **Combustion safety control**.

Flame-sensing device — that **component** of a **combustion safety control** that senses flame.

Flammable liquid — a liquid that has a **flash point** below 100°F (38°C) and that has a vapour pressure not exceeding 40 psia (276 kPa absolute) at 100°F (38°C).

Flash point — the minimum temperature at which a liquid within a **container** gives off vapour in sufficient concentration to form an ignitable mixture with air near the surface of the liquid.

Flexible connector — see **Connector**.

Flexible metallic hose — an all-metallic flexible gas conduit.

Floor furnace — a **furnace** that is suspended from the floor of the space being heated and that supplies warm air to such space through integral floor or wall grilles without the use of ducts.

Flue — an enclosed passageway for conveying **flue gases**.

Flue baffle — see **Baffle**.

Flue collar — that portion of an appliance

designed for the attachment of a draft hood, vent connector, or venting system. See Appendix C.

Flue damper — a movable plate for regulating the flow of *flue gases* and intended for installation either in the *flue* outlet of any gas *appliance* or in the *vent connector* from an individual *appliance* that is not equipped with a *draft control device*.

Automatic — a *flue damper* that is designed to fully open the *venting system* automatically before *ignition* of the main *burner* and is either interlocked to automatically close off the supply of gas to the *appliance* or provided with means to ensure that the *damper* will fall fully open upon loss of the driving medium.

Manually operated — a *flue damper* that is adjustable and manually set and locked in the desired position and is designed or constructed to provide a fixed minimum opening.

Flue gas dilution air — see **Air supply**.

Flue gases — *combustion products* and *excess air*.

Forced draft — see **Draft**.

Forced draft burner — see **Burner**.

Furnace — an indirect-fired, *flue*-connected, space-heating *appliance* that uses warm air as the heating medium, and usually has provision for the attachment of ducts.

Gallon — (except where specifically indicated otherwise) the Canada standard *gallon* as defined under the Canadian Weights and Measures Act, 1951, as amended 8 July 1971.

Note: *For the purpose of this Code, 1 imperial gallon may be considered to be equal to 1 Canadian standard gallon.*

Garage —

Private — a *building*, designed for the parking, storage, or repair of vehicles used to transport propane, that is *approved* by the

authority having jurisdiction for this purpose and is located on property owned or leased by the owner of the vehicles.

Repair — a *building* or part thereof where facilities are provided for the repair or servicing of a motor vehicle.

Storage — a *building* or part thereof used or intended for either the storage or parking of motor vehicles and that contains no provision for either the repair or servicing of such vehicles.

For practical purposes a repair garage may be considered any *garage*, other than a residential or parking garage, where it is reasonable to assume that repair or servicing of vehicles may take place.

Heat baffle — see **Baffle**.

Heater —

Catalytic — a *heater* that employs a porous matrix on or in which is distributed a catalytic agent such as platinum; the role of the matrix is to support the catalyst and to provide a surface on which the combustion of the hydrocarbon fuel vapour takes place.

Construction — a portable direct-fired unvented *heater* intended only for temporary use in heating *buildings* under construction, alteration, or repair.

Direct-fired make-up air (DFMAH) — a self-contained direct-fired air *heater* used only to heat outside air to replace inside air being exhausted and not intended for *building* heating.

Infra-red — a *heater* that transfers heat from the source to the heated objects without heating the intervening air.

Radiant — a *heater* that radiates heat to the surrounding air.

Heat reclaimer — a device installed either externally or internally to a *venting system* to extract heat from *flue gases*.

Heavy-duty fittings — those *fittings* referred to as 300 lb (135 kg) banded *fittings*.

Hose — a flexible conduit.

Hose connector — see **Connector**.

Ignition — the establishment of a flame.

Intermittent — a source of *ignition* that continues to function during the entire period that the flame is present.

Interrupted — a source of *ignition* that ceases to function after the trial-for-*ignition* period.

Indirect-fired appliance — an *appliance* in which the *combustion products* or *flue gases* are not mixed within the *appliance* with the medium being heated.

Induced draft — see **Draft**.

Industrial appliances — see **Commercial- and industrial-type appliance or equipment**.

Industrial building — see **Building**.

Installer — any individual, firm, corporation, or company that either directly or through a representative is engaged in the installation, replacement, repair, or servicing of gas piping, *venting systems*, *appliances*, *components*, accessories, or *equipment*, and whose representative is either experienced or trained, or both, in such work and has complied with the requirements of the *authority having jurisdiction*.

An *installer*, as defined in the B149.1 Code, is responsible for any work conducted in relation to gas or propane installations. An installer must be qualified by the authority having jurisdiction in order to perform any such work, and must adhere to all Code requirements unless otherwise approved by the authority having jurisdiction.

Insulating millboard — a factory-fabricated board formed with *noncombustible* materials, normally fibres, and having a thermal conductivity not exceeding.

$$1 \frac{\text{Btu} \cdot \text{inch}}{\text{h} \cdot \text{ft}^2 \cdot ^\circ \text{F}} \quad (0.144 \frac{\text{W}}{\text{m} \cdot \text{K}})$$

Lubricated plug-type valve — see **Valve**.

Masonry chimney — see **Chimney (masonry or concrete)**.

Maximum allowable operating pressure — the maximum pressure to which any *component* or portion of the fuel system can be subjected.

Mechanical air intake — a means to mechanically provide *ventilation* and/or *combustion air* requirements to a *building*.

Mechanical draft — see **Draft**.

Metal connector — see **Connector**.

Mobile housing — the term *mobile housing* includes all of the following *structures*:

Mobile home — a dwelling that consists of a vehicular portable *structure* built on a chassis and designed to be used with or without a permanent foundation and for connection to indicated utilities.

Mobile industrial or commercial structure — a *structure* not intended as a *dwelling unit*, towable on its own chassis, and for use without a permanent foundation. Such a *structure* is built specifically for commercial or industrial use, such as a construction office,

bunk house, wash house, kitchen and dining unit, library, television unit, industrial display unit, laboratory unit, or medical clinic.

Multiple-section mobile home — a single *structure* composed of separate mobile units each towable on its own chassis, each of which when towed to the site is coupled together mechanically and electrically to form a single *structure*. These are sometimes referred to as double-wide *mobile homes*, when only two units are joined together.

Swing out and expandable room-section mobile home — a *mobile home* that can be telescoped when towed and expanded later for additional capacity.

The determination of when a mobile home ceases to be used as a mobile home and is considered to be a permanently fixed structure is extremely important in practice (see Clause 3.8.2). In general, once the means of transportation (wheels, axles, and towing gear) are removed and a permanent support system, to which the mobile home is securely attached, is provided, the mobile home is deemed to be a permanently fixed structure. Consult the authority having jurisdiction for further clarification.

Mobile outdoor food service unit — a unit used outdoors for preparation and dispensing of food or beverages and that contains *appliances* or *equipment* operated by propane in the vapour state. The unit may be equipped with wheels and its own motive power.

N/A — not applicable due to physical or geometric constraints. See Appendix C.

NAT Max — the maximum appliance input rating of a **Category I appliance** equipped with a **draft hood** that could be attached to the vent. There are no minimum appliance input ratings for drafthood-equipped appliances. See Appendix C.

NAT+NAT — the maximum combined input

rating of two or more drafthood-equipped appliances attached to the common vent. See Appendix C.

Natural draft — see **Draft**.

Natural draft burner — see **Burner**.

NGV — natural gas stored in a gaseous state to be used as engine fuel for a highway vehicle.

Noncombustible — material that conforms to ULC Standard CAN4-S114.

NR — not recommended due to potential for condensate formation and/or pressurization of the venting system. See Appendix C.

Operating control — a control used to regulate or control the normal operation of an *appliance*.

Package unit — an *appliance* supplied as a complete unit, including *burner*, controls, and integral wiring.

Pilot — a flame that is used to ignite a gas/air or propane/air mixture at the main *burner* or *burners*.

Continuous — a *pilot* that burns without turndown throughout the entire time the *burner* is in service, whether the main *burner* is firing or not.

Expanding — a *pilot* that burns at low turndown throughout the entire time the *burner* is in service, whether or not the main *burner* is firing, except that upon a call for heat, the fuel flow to the *pilot* is automatically increased to produce a flame that will reliably ignite the main *burner* fuel.

Intermittent — a *pilot* that is automatically lighted each time there is a call for heat and that burns during the entire period that the main *burner* is firing.

Interrupted — a *pilot* that is automatically lighted each time there is a call for heat and

that is cut off automatically at the end of the trial-for-*ignition* period of the main *burner*.

Proved — a *pilot* flame supervised by a primary safety control that senses the presence of the *pilot* prior to gas being admitted to the main *burner*.

Point of transfer — the dispensing *hose* inlet connection.

Power venter — a field-installed device that provides *mechanical draft* and, when installed, is located between the *appliance flue* outlet or *draft control device* and the *vent* or *chimney* termination, or at the *vent* or *chimney* termination.

Primary air — see **Air supply**.

Products of combustion — see **Combustion products**.

Purge — to replace the existing fluid (gaseous or liquid) in piping, tubing, *equipment*, a *container*, or an *appliance* with a desired fluid.

Purge burner — a *burner* equipped with a constant *ignition* source and a flame arrestor intended to burn the escaping (discharged) gas during purging operations.

Quick-disconnect device — a hand-operated device that provides for connecting and disconnecting either an *appliance* or an *appliance connector* to a gas supply, and that is equipped with an automatic means to shut off the gas supply when the device is disconnected.

Readily accessible — capable of being reached quickly for operation, renewal, servicing, or inspection, without requiring the climbing over or removal of an obstacle or the use of a portable ladder.

An appliance installation is considered *readily accessible* when the applicable access requirements cited in the B149.1 Code have been satisfied. The obstacles referred to in the above definition are only those existing at the time of installation. Installers are not responsible for obstacles created by the occupants after an installation is completed.

Recreational vehicle — a portable *structure* intended as temporary accommodation for travel, vacation, or recreational use. Such a *structure* includes a *travel trailer*, *motorized home*, *slide-in camper*, *chassis-mounted camper*, or *tent trailer*, defined as follows:

Chassis-mounted camper — an accommodation body that attaches onto a truck chassis and is not intended for removal.

Motorized home — a vehicular portable *structure* of self-propelled design.

Slide-in camper — an accommodation body that fits into a standard vehicle and is designed to be easily removable.

Tent trailer — a vehicular portable *structure* built on its own chassis and having a rigid or canvas top and side walls that may be folded or otherwise condensed for transit.

Travel trailer — a vehicular portable *structure* intended to be towed by a motor vehicle and that does not fold up or reduce in size for transit.

Regulator —

Appliance regulator — a *pressure regulator* located in the *valve train* of an *appliance*.

Pressure regulator — a device, either adjustable or nonadjustable, for controlling and maintaining, within acceptable limits, a uniform outlet pressure.

Service regulator — a *pressure regulator* installed on a service line to control the

pressure of the gas delivered to the customer.

System regulator — a *pressure regulator* installed in a piping or tubing system downstream of the *service regulator* and upstream of the *appliance regulator*, also known as a second-stage regulator for propane.

Two-stage regulation — a pressure-reducing system that reduces *container* pressure to utilization pressure by the use of two separate *regulators* in series or a combination two-stage regulator, ie, a *service regulator* and a *system regulator*.

Relief device — a device designed to open to prevent a rise of gas pressure in excess of a specified value due to an emergency or abnormal conditions.

Residential appliance — an *appliance* commonly used in, but not restricted to, a *dwelling unit*.

Commercial and industrial type appliances or equipment are differentiated from *residential appliances* by their application. Within the Code, requirements for these two types differ due to the assumed differences in features such as materials, ruggedness, and durability. However, this distinction may not always be practically applied.

Safety limit control — a safety control intended to prevent an unsafe condition of temperature, pressure, or liquid level.

Safety shut-off valve — see **Valve**.

Secondary air — see **Air supply**.

Semirigid Connector — see **Connector**.

Set pressure — the start-to-discharge pressure for which a relief *valve* is set and marked.

Δ **Space, confined** — a space whose volume is less than 50 ft³ per 1000 Btuh (4.8 m³ per kW) of the aggregate input rating of all appliances installed in that space.

Structure — the entire *building* in which an *appliance(s)* is installed.

For practical purposes, a *structure* comprises the entire volume of the building and its attached enclosures, and freely communicates air to the installed appliance(s).

Tank — (with respect to NGV/ propane storage) the class of *container* for the storage and transportation of gas, designed and fabricated in accordance with CSA Standard B51.

Valve — a device by which the flow of a fluid may be started, stopped, or regulated by a movable part that opens or obstructs passage.

Back check — a *valve* that is normally closed and allows flow in only one direction.

Cylinder — a *valve* fitted to a *cylinder*.

Emergency shut-off — a *valve* that is part of a system that is designed to limit and shut down the flow of propane in the event that a vehicle moves away from a transfer point with transfer *hose* or swivel-type piping connected to it.

Excess flow — a *valve* designed to close when the liquid or vapour passing through it exceeds a prescribed flow rate as determined by a pressure drop across the *valve*.

Fast-closing — an automatic *valve* that has a closing time of less than 5 s upon being de-energized.

Hydrostatic relief — a pressure relief *valve* installed in a liquid propane line.

Internal — a *valve* designed and installed so that its seat is within a *tank* and the arrangement of the parts of the valve are such that damage to the parts outside the tank will not prevent effective seating of the valve.

Internal excess flow — an *excess flow valve* that remains functional within the *tank*, when any portion of the *valve* external to the *tank's* perimeter is sheared off or otherwise damaged. An *internal excess flow valve* may be integral to another valve.

Note: *The perimeter of the tank is taken to mean not only the surface of the tank's shell and ends, but also the outline of any boss, spigot, or nozzle welded to the tank so as to project outwards from it. The outline of welded brackets, mountings, guards, subcompartments, and the like are not considered part of the perimeter for the purpose of this definition.*

Internal relief — a pressure relief *valve* that is built into the body of the diaphragm assembly of a *pressure regulator*.

Line relief — a relief *valve* installed in the piping or tubing system downstream of a final-stage *pressure regulator* that is not equipped with an *internal relief valve*.

Lubricated plug type — a manually operated *valve* of the plug and barrel type that is

- (a) provided with means for maintaining a lubricant between its bearing surfaces;
- (b) so designed that the lapped bearing surfaces can be lubricated and the lubricant level maintained without removing the *valve* from service;
- (c) so constructed that the lubricant can be stored in a reservoir so as to be distributed evenly over the entire lapped bearing surfaces of the *valve* when the plug is rotated; and
- (d) equipped with built-in stops to limit the rotation of the plug to one quarter turn when fully opening or fully closing the *valve*.

Safety shut-off — a *valve* that automatically shuts off the supply of gas when de-energized by a *combustion safety control*, *safety limit control*, or loss of actuating medium.

Stop-fill valve — a device in a *container* that is intended to automatically shut off the flow of liquid into the *container* when a predetermined fixed level is achieved.

Test firing (firing valve) — a manually operated, lubricated plug type, quarter turn

valve that has stops in the open and closed positions and has an attached handle, or loose *fitting* key, or extended handle wrench, and that is located downstream of all *safety shut-off valves* on the *valve train* and as close to the *burner* as is practicable.

Valve train — the combination of *valves*, controls, and piping and tubing of an *appliance* upstream from the manifold through which gas is supplied to the *appliance* and by which gas is controlled.

Vaporizer — an *appliance* for converting liquid propane to vapour by means other than atmospheric heat transfer through the surface of the *container*.

Direct-fired — a *vaporizer* in which heat furnished by a flame is directly applied to a heat exchange surface in contact with the liquid propane to be vaporized.

Indirect — a *vaporizer* in which heat furnished by steam, hot water, or other heating medium is applied to a vaporizing chamber tubing, pipe coils, or other heat exchange surface containing the liquid propane to be vaporized. The heating of the medium being used occurs at a point remote from the *vaporizer*.

Vent — that portion of a *venting system* designed to convey *flue gases* directly to the outdoors from either a *vent connector* or an *appliance* when a *vent connector* is not used.

Type B — a *vent* complying with ULC Standard CAN/ULC-S605 and consisting entirely of factory-made parts, each designed to be assembled with the other without requiring field fabrication, and intended for venting gas *appliances*.

Type BH — a *vent* complying with ULC Standard ULC-S636 and consisting entirely of factory-made parts, each designed to be assembled with the other without requiring field fabrication, and intended for venting gas *appliances*.

Type BW — a *vent* complying with ULC Standard CAN/ULC-S605 and consisting entirely of factory-made parts, each designed to be assembled with the other without requiring field fabrication, and intended for venting only wall *furnaces* for use with such type of *vent*.

Type L — a *vent* complying with ULC Standard ULC-S609 and consisting of factory-made parts, each designed to be assembled with the other without requiring field fabrication.

Vent connector — that part of a *venting system* that conducts the *flue gases* from the *flue* collar of an *appliance* to a *chimney* or *vent*, and that may include a *draft control device*.

Ventilation — (with respect to the space in which an *appliance* is installed) the removal of inside air, leaked or spilled *products of combustion*, or *flue gases* from that space to outside the space and the replacement of same by air from outside that space.

Prior to the introduction of mechanical ventilation requirements in building codes, installers of gas and propane appliances were responsible for the *ventilation* of the space containing the installed appliances. With few exceptions, this is no longer the case. However, it is recommended that installers check to see that adequate ventilation has been provided.

Ventilation air — see **Air supply**.

Venting system — a system for the removal of *flue gases* to the outdoors by means of a *chimney*, *vent connector*, *vent*, or a natural or mechanical exhaust system.

Δ **Special venting system** — a venting system certified with the appliance and either supplied or specified by the appliance manufacturer.

For practical purposes, a *venting system* consists of everything downstream of the appliance flue collar that is involved in the venting of flue gases to the outdoors. For example, in the case of a natural draft appliance, it consists of the vent connector, Type B vent or chimney, and the vent or chimney cap. Where a *special venting system* is used, all of the components required by the manufacturer's certified installation instructions are considered to be the venting system.

Where required, the outside air supply is also considered to be part of the venting system.

VRA — vehicle refuelling appliance.

Wash-mobile — a mobile outdoor unit that uses propane-heated water, or a solution, for the purpose of cleaning.

Zero governor — a regulating device that is adjusted to deliver gas at atmospheric pressure within its flow rating.

2.2 Abbreviations

2.2.1 Abbreviations for names of organizations.

Abbreviations for names of organizations have been provided below.

ANSI American National Standards Institute,
1430 Broadway, New York,
New York 10018, USA

ASTM American Society for Testing and
Materials
1916 Race Street, Philadelphia,
Pennsylvania 19103, USA

CGA Canadian Gas Association
(CGA Standards, Recommended
Practices, and Codes are now published
by CSA.)

CGA Compressed Gas Association, Inc.
1725 Jefferson Davis Highway,
Arlington, Virginia 22202-4100, USA

CGSB	Canadian General Standards Board Department of Supply and Services, 9C1, Phase III, 11 Laurier Street, Hull, Québec K1A 1G6
CSA	CSA International 178 Rexdale Blvd., Toronto, Ontario M9W 1R3
DOT	Department of Transportation 400 - 7th Street, Washington, D.C. 20590, USA
NFPA	National Fire Protection Association 1 Batterymarch Park, Quincy, Massachusetts 02269, USA
NPGA	National Propane Gas Association 1600 Eisenhower Lane, Suite 100, Lisle, Illinois 60532, USA
NRCC	National Research Council Canada Codes Section, Ottawa, Ontario K1A 0R6
PGAC	Propane Gas Association of Canada Alberta Stock Exchange Building, Suite 2150, 300 - 5th Avenue S.W., Calgary, Alberta T2P 3C4
TC	Transport Canada 330 Sparks Street, Ottawa, Ontario K1A 0N5
UL	Underwriters Laboratories Inc. 333 Pfingsten Road, Northbrook, Illinois 60062, USA
ULC	Underwriters' Laboratories of Canada 7 Crouse Road, Scarborough, Ontario M1R 3A9

2.2.2 Abbreviations of words and phrases.

For convenient reference, the abbreviations of words and phrases found in the B149.1 Code and appearing throughout this handbook have been listed below.

B&SG	Brown and Sharpe gauge
Btuh	British thermal unit per hour
°C	degree Celsius
cfm	cubic foot per minute
dm	decimeter
°F	degree Fahrenheit
ft	foot
g	gram
gal	gallon
GSG	galvanized sheet gauge
GPH	gallon per hour
h	hour
in	inches
kg	kilogram
kj	kilojoule
kPa	kilopascal
kW	kilowatt
lb	pound
L	litre
mA	milliampere
min	minute
mm	millimetre
MSG	manufacturers standard gauge
N	Newton
No.	number
NPS	nominal pipe size
oz	ounce
Pa	pascal
ppm	parts per million
psig	pound per square inch gauge
pt	pint
s	second
scf	standard cubic feet
SI	International System of Units
SWG	steel wire gauge
USWG	United States water gallon
V	volt
W	watt
w.c.	water column
WC	water capacity
wt	weight

2.3 Reference Publications

Refer to the B149.1 Code for the listing of reference publications. It is important to ensure that the proper reference publication is used when interpreting and applying the B149 Code. Always check the title and year of any reference publication used, since earlier or later versions may contain requirements that have not been approved by the Code committees or authority having jurisdiction.

3. GENERAL

Clause 3 of the B149.1 Code explains the general application of the Code. Requirements for the approval of appliances, accessories, components, equipment, and material are set out in Clause 3. It also outlines the responsibilities of the appliance installer and defines the skills and training he or she requires. In addition, it provides general requirements applicable to all gas-burning appliance installations in areas such as suitability of use, electrical safety, clearances to combustible material, and accessibility. Installation requirements for specific appliances are provided in Clause 6 of the Code.

A key point in Clause 3 is that the requirements of the B149.1 Code take precedence over those found in referenced standards or manufacturer's instructions, unless otherwise approved by the authority having jurisdiction. This serves to remind designers and installers to carefully review applicable Code requirements in relation to specific installations, particularly where new or unfamiliar products are being considered.

Ensure full familiarity with the requirements of Clause 3, and use them as a checklist when planning or performing an installation.

Key Points

- Clause 3 provides general requirements applicable to all gas-burning appliance installations, as well as to the training and skills required of installers.
- Clause 3 establishes the precedence of the B149.1 Code requirements over referenced standards and manufacturer's instructions, unless otherwise approved by the authority having jurisdiction.
- Ensure complete familiarity with Clause 3 requirements, and use them as a basic checklist when planning or reviewing proposed appliance installations.

3. GENERAL

3.1 Application

Intent and Rationale — Clause 3.1

Clause 3.1 is intended to establish the general application of the B149.1 Code.

Yard/pound (imperial) units of measurement form the basis of the B149.1 Code since many of the requirements were originally based on these units, and testing and certification continue to reference them. Since metric units cited in the B149.1 Code are approximate, imperial units of measurement must be used to determine compliance with Code requirements.

For practical purposes, “shall” may be replaced with “must”, and is used to indicate a mandatory Code requirement, unless otherwise approved by the authority having jurisdiction.

The Code takes precedence over referenced documents, such as standards, because changes to referenced documents may not necessarily be approved by the B149.1 Code committees.

Manufacturer's certified instructions are based on approved test methods intended to ensure satisfactory performance and Code compliance. Instructions that conflict with Code requirements must be approved or may be modified by the authority having jurisdiction, for reasons of safety, performance, and enforceability.

NOTE ON DIMENSIONAL TOLERANCES

- When interpreting dimensional requirements in the field (clearances, sizes, thicknesses, etc), reasonable tolerances should be allowed for practical purposes.
- Employ consultation and common sense both prior to installation and during field inspections.
- Consult applicable standards for specific tolerances and equivalents.



Better Practice

In the preparation of drawings and specifications, it is recommended that one adhere to either imperial or metric measurements. This will help to avoid conversion errors and to produce documents that are more economical and easier to read.



Looking Ahead

When installing unfamiliar equipment (for example, duct furnaces), check the applicable installation requirements in Clause 6 to identify any conflicts in the requirements of the Code and of the manufacturer's certified installation instructions. Where conflicts are identified, resolve them by contacting the authority having jurisdiction prior to installation.

3.2 Approval of Appliances, Accessories, Components, Equipment, and Material

Intent and Rationale — Clause 3.2

The requirements of Clause 3.2 are intended to establish the procedures for the approval of appliances, accessories, components, equipment, and materials.

The suitability of appliances, accessories, components, equipment, and materials is generally determined by certification and the requirements of the B149.1 Code.

Where an installation does not match Code requirements, permission in writing from the authority having jurisdiction is required. This permission only applies to the particular installation for which it is given, because each situation may be different, and what makes sense in one case may not make sense in another.

In some cases, an installation may require field assembly or construction of an appliance. Such cases always require prior approval of the authority having jurisdiction in order to ensure suitability and proper appliance performance. The field assembly or construction of appliances falls under CSA B149.3-00, *Code for the Field Approval of Fuel-Related Components on Appliances and Equipment*.

3.3 Responsibilities of the Installer

Intent and Rationale — Clause 3.3

The requirements of Clause 3.3 are intended to ensure that the installer adheres to all Code requirements and installation procedures. Most importantly, this involves all required pressure testing, starting up and ensuring the safe working order of the appliance, shutting down any system that has been displaced or replaced by gas, and instructing the user in the safe and proper operation of the installed appliance.

Field inspections cannot guarantee complete compliance with Code requirements. For this reason, the installer remains responsible for all aspects of any appliance installation. Clause 3.3 outlines the minimum practical considerations of the installation that fall within the installer's area of responsibility. For replacements or conversions, the installer is responsible for supplying the manufacturer's operating instructions, and instructing the user in the safe and correct operation of all appliances or equipment installed. However, in the case of new construction where the user does not occupy the building or facility at the time of installation, this responsibility is transferred to the builder for practical purposes. Suitable arrangements for supplying instructions must be made between the installer and builder.



Looking Ahead

Refer to Clause 6 of the Code to determine whether a proposed installation is covered by these requirements. Where it is not, check to see if the application is covered by the manufacturer's certified installation instructions. Consult with the authority having jurisdiction if the suitability of the installation is still unclear.



Looking Ahead

Refer to Clause 5.22.2 to determine the pressure testing requirements applying to an installation. Ensure that all testing equipment and materials are available. Schedule inspections accordingly to avoid costly delays.



Better Practice

Budget sufficient time to instruct the user in the operation of installed equipment. Ensure that operating instructions, owner's manuals, and warranties are collected and provided to the user, preferably in a labelled envelope.

3.4 Training and Quality of Labour

3.4.1 All work shall be done in a skilful, thorough manner. Careful attention shall be paid not only to the mechanical execution of the work but also to the arrangement of the installation.

Intent and Rationale — Clause 3.4.1

The intent of this requirement is to establish general guidelines for the performance of installations. This requirement assumes an ability to comprehend the relationship of the installation to all other related systems.

Persons involved in the installation of appliances and equipment must be capable of installing these competently and integrating their arrangement with existing and reasonably foreseeable systems. An arrangement is deemed acceptable if it complies with all requirements of the Code.

3.4.2 Personnel performing installation, operation, and maintenance work shall be properly trained in such functions.

Intent and Rationale — Clause 3.4.2

The intent of this requirement is to ensure that installers are properly trained and competent in the tasks they perform.

The rationale for this requirement is conveyed within the requirement itself.

NOTE ON TRAINING

Detailed descriptions of the knowledge and skills required by installers have been prepared by a number of authorities having jurisdiction. Materials such as these may prove useful in developing suitable training programs for installers. For the training requirements in your jurisdiction, please contact the applicable authority. A list of the authorities is provided in the Code under the Interprovincial Gas Advisory Council.

3.5 Suitability of Use

Intent and Rationale — Clause 3.5

The intent of Clause 3.5 is to avoid the installation of appliances that are not suitable for their intended use.

The suitability of appliances for the type of gas available must be confirmed prior to installation, since improper operation may result. This is particularly the case when converting appliance gas types, for example, from natural gas to propane. Conversions must be in accordance with manufacturer's certified instructions; where these do not exist, the converted appliance must be approved by the authority having jurisdiction. The marking of the appliance rating plate by the fitter who makes the conversion, to indicate the fuel supplied, is the most practical means of updating the appliance rating plate information.

Depending on existing systems or conditions, an appliance may create a hazard and, therefore, is prohibited. For example, natural draft appliances must not be installed in spaces where air exhausting equipment may result in spillage of the products of combustion. The inspection of appliances used and the determination of their suitability by the installer represents the most practical means currently available to ensure safety in the field.

3.6 Meter/Regulator/Service Installations

Intent and Rationale — Clause 3.6

The intent of this Clause is to establish the standard governing meter and regulator installations, and to restrict the performance of all alterations, repairs, tests, services, removals, changes, installations, and connections to authorized personnel.

The rationale for these requirements is conveyed within the requirements themselves.

NOTE ON SERVICE INSTALLATIONS

Meter/regulator/service installations are normally performed by the utility supplying natural gas or propane. Appendix D of the B149.1 Code provides additional information for natural gas and propane service installations.

The two primary considerations for the installer, in the case of new construction, are as follows:

- **determine the location of new service installations from your local gas utility or propane distributor prior to planning and pricing appliance installations; this is particularly important for piping layout and side-wall venting appliances;**
- **where an acceptable alternative location for the meter/regulator will improve the practicality of an installation, discuss this possibility with your gas utility or propane distributor as soon as possible.**

Guidelines on meter/regulator and service locations for existing buildings are usually available from your local gas utility or propane distributor. These are important to review when planning a conversion, such as that from electric to natural gas heating, since the meter/regulator location may affect the ease and cost of the conversion significantly.

3.7 Electrical Connections and Components

Intent and Rationale — Clause 3.7

The intent of this Clause is to ensure the electrical safety of wiring serving appliances, components, accessories, and equipment.

Adherence to the requirements of the *Canadian Electrical Code, Part I*, or the requirements of the authority having jurisdiction, represents the currently acceptable level of electrical safety.

The wiring for any electrical device used with an appliance must comply with the appliance wiring diagram since these methods represent the only certified means of ensuring electrical safety.

3.8 Mobile Homes

Intent and Rationale — Clause 3.8

The intent of Clause 3.8 is to refer the installation of gas-burning appliances and supply piping in mobile homes to CSA Standard Z240.4.1, which certifies mobile homes. It is also intended to define, when a mobile home is converted to a permanently fixed structure, the applicable Code requirements for the entire system serving the structure.

Mobile homes pose special requirements for gas-burning appliance installations, hence the installation of gas-burning appliances and supply piping must be addressed under a separate standard. The installation of piping from the supply line to the point of connection to a mobile home must conform to the requirements of the authority having jurisdiction, since local experience has proven more effective in assuring acceptable methods of connection. One standard method of connection would not be appropriate for all the geographical areas of the country.

When mobile homes are converted into permanently fixed dwellings or structures, they are assumed to be like normal buildings, and therefore all applicable requirements of the Code must be met. For guidelines on determining when a mobile home is considered permanently fixed, refer to the commentary box under the definition of mobile housing in Clause 2 of this Handbook.

3.9 Hazardous Locations

3.9.1 An *appliance* shall not be installed in a room that has an atmosphere containing vapours corrosive to an *appliance* or **venting system**.

3.9.2 An *appliance*, unless *certified* for installation in a hazardous location, shall not be installed in any location where a flammable vapour, *combustible* dust or fibres, or an explosive mixture is present.

Intent and Rationale — Clause 3.9

The requirements of Clause 3.9 are intended to prohibit the installation of appliances in locations that may damage the appliance or venting system in a manner that results in a potential hazard or may directly cause hazards, such as fire or explosion.

Clause 3.9.1 prohibits the installation of appliances in environments that may corrode the heat exchanger or venting system. Corrosion of these components may lead to products of combustion entering the building.

Clause 3.9.2 prohibits the installation of appliances not approved for hazardous locations in environments where fire or explosion may result due to exposed flame, hot contact surfaces, or electrical arcing (sparks) during appliance operation.

NOTE ON HAZARDOUS ENVIRONMENTS

Hazardous environments, in relation to gas appliance installations, may be practically defined as any space containing concentrations of flammable vapours, combustible dust or fibres, or explosive mixtures that may be ignited by appliance operation. Technical information on hazardous environments (see NFPA Standard 325M -1984) is available from the National Fire Protection Agency (NFPA), and general guidelines are published in Chapter 11 of the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) 1997 *Fundamentals Handbook*. Extreme caution is recommended when assessing hazardous environments and specifying appliances for installation in such environments.

3.10 Smoking**Intent and Rationale — Clause 3.10**

The intent of Clause 3.10 is to prohibit smoking or any other source of ignition in areas containing potentially flammable or explosive concentrations of gas.

The rationale for this requirement is conveyed within the requirement itself.

**Looking Ahead**

Refer to Clause 5.23 for the proper purging procedures that are required prior to permitting smoking, welding, or any other activity involving a source of ignition.

3.11 Isolation of Safety Devices**Intent and Rationale — Clause 3.11**

Clause 3.11 is intended to prohibit the isolation of required safety devices, except with the approval of the authority having jurisdiction.

Safety devices, such as safety shut-off valves, safety limit controls, or relief valves, must not be isolated or rendered inoperative, in order to maintain the level of safety required by the Code. Under certain circumstances, such as large commercial installations, where maintenance, repair, or replacement is to be performed without total shutdown of operations, prior approval of the authority having jurisdiction may be requested to temporarily isolate the safety devices for the duration of the work.

3.12 Leak Detection

Intent and Rationale — Clause 3.12

Clause 3.12 is intended to prohibit the use of methods or devices that are capable of igniting leaking gas.

Any potential source of ignition must not be used where gas leakage is suspected. Electrical devices that may be exposed to areas of gas leakage must conform to Class I Locations of the *Canadian Electrical Code*. Class I devices are sealed to prevent the migration of gas into the device and designed to fully contain an explosion within the device if migration accidentally occurs.

acceptable to the **authority having jurisdiction**, and so marked on the **appliance** nameplate; or

- (b) protection is provided for the **combustible** material, and such protection and such reduced clearance is in accordance with Table 3.13.2 or 3.13.2 (M).

3.13 Appliance Clearances to Combustible Material

3.13.1 A clearance required in Clause 6 between an **appliance** and **combustible** material shall be considered minimum without protection and shall be measured from the **appliance**, disregarding either the **burner** or any other projecting **component**.

Intent and Rationale — Clause 3.13.1

Clause 3.13.1 is intended to establish how clearances between appliances and combustible materials required in Clause 6 are measured.

The method of measuring clearances between appliances and combustible materials stated in Clause 3.13.1 is consistent with the method employed during appliance certification testing. An acceptable level of safety can only be consistently maintained if the same method of measuring clearances is employed in the field.

Intent and Rationale — Clause 3.13.2

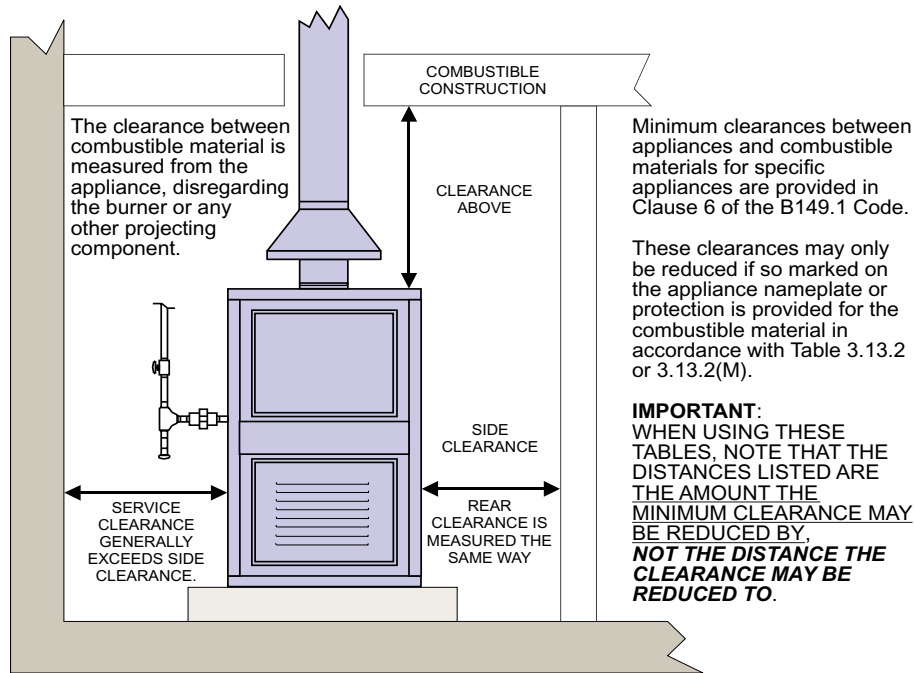
The intent of Clause 3.13.2 is to ensure that appliances are not installed so close to combustible materials as to start a fire.

Minimum clearances to combustible materials for appliances are specified in Clause 6 of the Code, and are based on proven laboratory testing. Appliances may be installed with reduced clearances provided they have been certified, the certification has been accepted by the authority having jurisdiction, and the clearances are marked on the appliance nameplate to enable field verification. Appliances may also be installed with less clearance than that required in Clause 6 provided combustible materials are protected according to Table 3.13.2 or 3.13.2 (M).

3.13.2 A clearance to **combustible** material specified in Clause 6 shall not be reduced unless

- (a) such reduced clearance is **certified** as safe by a nationally recognized certification organization

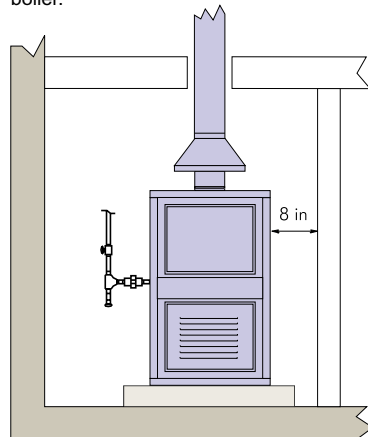
CLEARANCE MEASUREMENTS



APPLYING CLEARANCE REQUIREMENTS

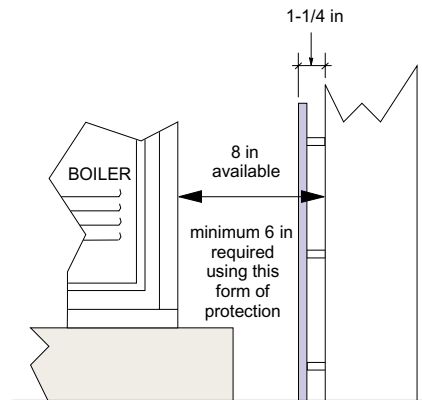
Problem:

A boiler manufacturer's appliance nameplate requires a minimum 12 in clearance of the sides and rear to combustible construction. Approximately 8 in clearance is available between the replacement boiler and the combustible wall shown below. Determine a method of protection which will permit installation without moving the boiler or the combustible wall to the right of the boiler.



Solution:

According to Table 3.13.2, 1/4 in insulating millboard spaced out 1 in will allow the side clearance to be reduced by 6 in. This means that after installation of the protection, the side clearance measured from the appliance to the outer face of combustible material, disregarding any intervening protection, must be at least 6 in (12 in - 6 in reduction). The 8 in available provides 2 in more clearance than required using this means of protection.



NOTE:

THE DISTANCES LISTED ARE THE AMOUNT THE MINIMUM CLEARANCE MAY BE **REDUCED BY**, NOT THE AMOUNT THE CLEARANCE MAY BE **REDUCED TO**.

TABLE 3.13.2
Appliance Clearance Reduction (inches) with
Specified Forms of Protection*

Type of Protection Applied to the <i>combustible</i> material unless otherwise specified and covering all surfaces with the distance specified as the required clearance with no protection	Where the required clearance with no protection is											
	36 in & greater		18 to 35 in		12 to 17 in		9 to 11 in		6 to 8 in		3 to 5 in	
	Clearance may be reduced by											
	Sides Above & rear		Sides & Above rear		Sides & Above rear		Sides & Above rear		Sides & Above rear		Sides Above & rear	
Thicknesses are minimum												
(a) 1/4 in <i>insulating millboard</i> spaced out 1 in	6	18	3	9	3	6	3	5	3	4	2	2
(b) 28 gauge sheet metal on 1/4 in <i>insulating millboard</i>	12	18	6	9	3	6	3	5	3	4	2	2
(c) 28 gauge sheet metal spaced out 1 in	18	24	9	12	6	8	5	6	4	4	2	2
(d) 28 gauge sheet metal on 1/8 in <i>insulating millboard</i> spaced out 1 in	18	24	9	12	6	8	5	6	4	4	2	2
(e) 1/4 in <i>insulating millboard</i> on 1 in mineral wool batts reinforced with wire mesh or equivalent	18	24	12	12	8	8	6	6	4	4	2	2
(f) 22 gauge sheet metal on 1 in mineral wool batts reinforced with wire or equivalent	18	24	12	15	10	10	7	7	4	4	2	2
(g) 1/4 in <i>insulating millboard</i>	0	0	0	0	0	0	0	0	2	2	1	1
*NOTE: All clearances shall be measured from the outer surface of the <i>equipment</i> to the <i>combustible</i> material disregarding any intervening protection applied to the <i>combustible</i> material.												

TABLE 3.13.2 (M)
Appliance Clearance Reduction (mm) with
Specified Forms of Protection*

Type of Protection Applied to the <i>combustible</i> material unless otherwise specified and covering all surfaces with the distance specified as the required clearance with no protection	Where the required clearance with no protection is											
	900 mm & greater		450 to 900 mm		300 to 430 mm		225 to 327 mm		150 to 200 mm		75 to 125 mm	
	Clearance may be reduced by											
	Sides Above & rear		Sides & rear		Sides Above & rear		Sides Above & rear		Sides Above & rear		Sides Above & rear	
Thicknesses are minimum												
(a) 6 mm <i>insulating millboard</i> spaced out 25 mm	150	450	75	225	75	150	75	125	75	100	50	50
(b) 0.3 mm sheet metal on 6 mm <i>insulating millboard</i>	300	450	150	225	75	150	75	125	75	100	50	50
(c) 0.3 mm sheet metal spaced out 25 mm	450	600	225	300	150	200	125	150	100	100	50	50
(d) 0.3 mm sheet metal on 3 mm <i>insulating millboard</i> spaced out 25 mm	450	600	225	300	150	200	125	150	100	100	50	50
(e) 6 mm <i>insulating millboard</i> on 25 mm mineral wool batts reinforced with wire mesh or equivalent	450	600	300	300	200	200	150	150	100	100	50	50
(f) 0.68 mm sheet metal on 25 mm mineral wool batts reinforced with wire or equivalent	450	600	300	375	250	250	175	175	100	100	50	50
(g) 6 mm <i>insulating millboard</i>	0	0	0	0	0	0	0	0	50	50	25	25
*NOTE: All clearances shall be measured from the outer surface of the <i>equipment</i> to the <i>combustible</i> material disregarding any intervening protection applied to the <i>combustible</i> material.												

Intent and Rationale — Clause 3.13.3

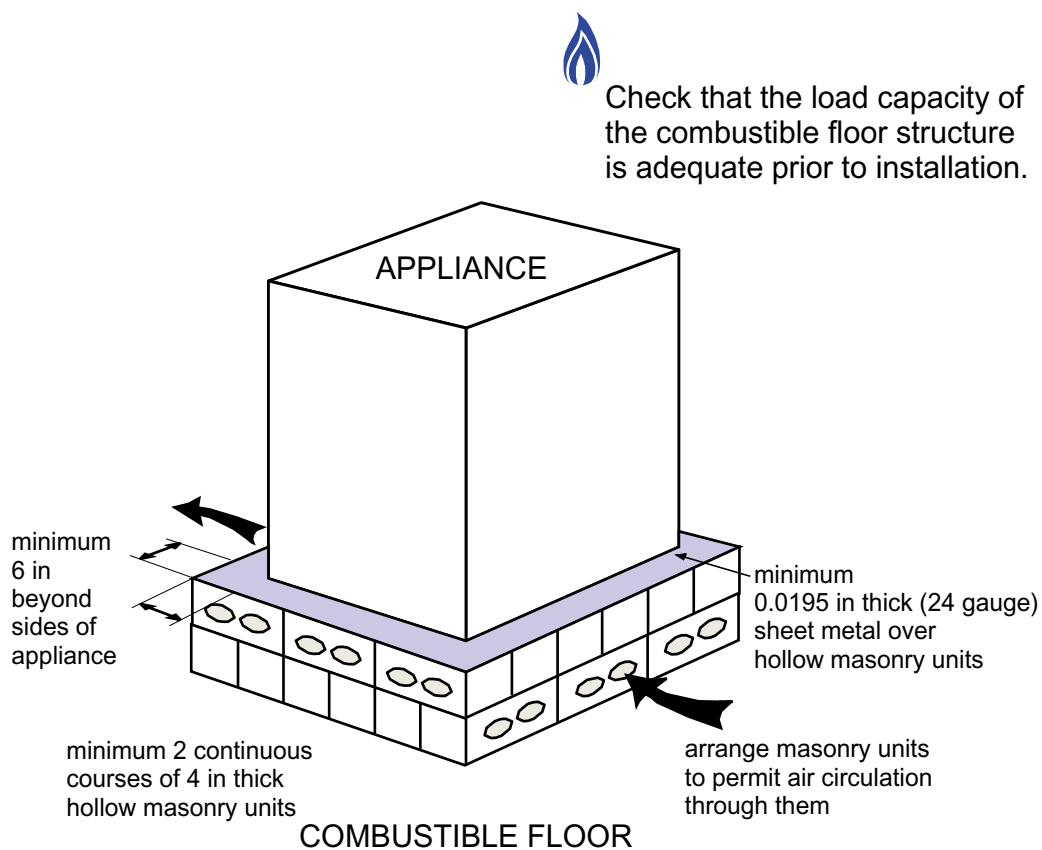
Clause 3.13.3 is intended to permit the installation of appliances that are not certified for installation on combustible flooring on floors of combustible material.

The rationale for this requirement is based on acceptable past performance, and the requirements are illustrated below.

Intent and Rationale — Clause 3.13.4

Clause 3.13.4 is intended to establish heater clearance requirements in aircraft storage and servicing areas.

The rationale for this requirement is conveyed within the requirement itself.

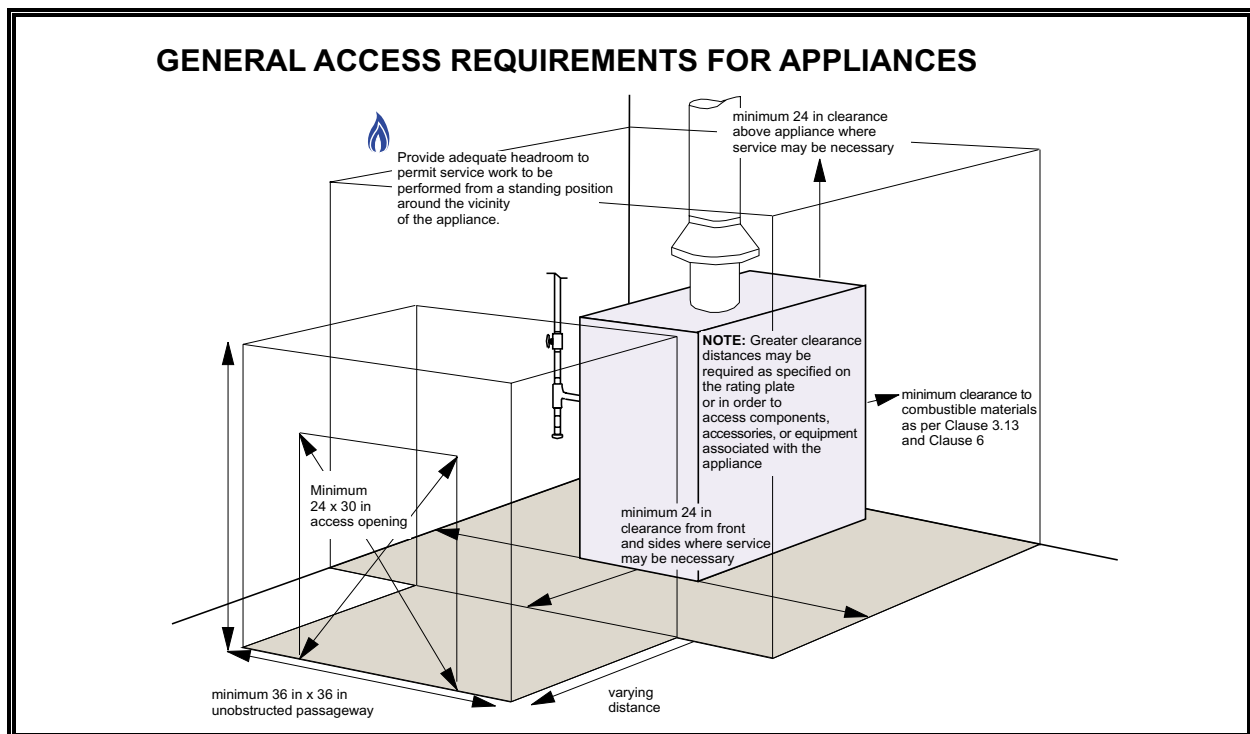
APPLIANCES ON COMBUSTIBLE FLOORS

3.14 Accessibility

Intent and Rationale — Clause 3.14

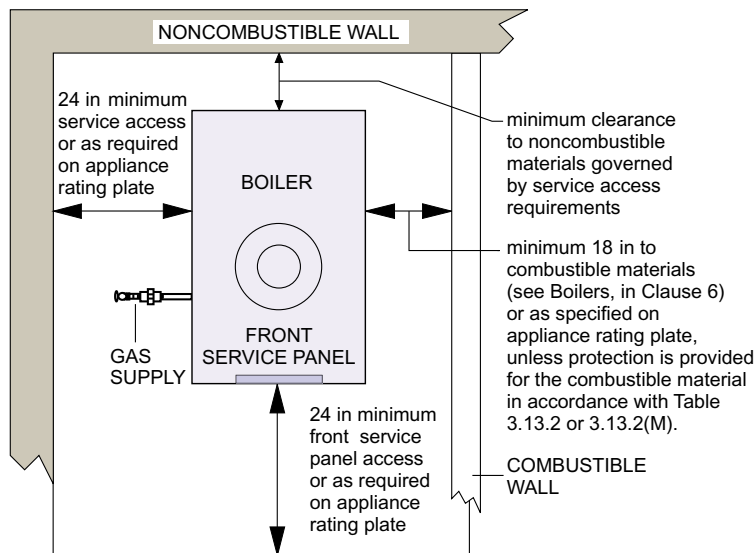
The intent of Clause 3.14 is to provide sufficient access to appliances to permit maintenance, repair, and replacement.

The rationale for Clause 3.14 is based on past experience and is conveyed within the requirements themselves, except for Clauses 3.14.5, 3.14.6, and 3.14.7.



APPLYING ACCESS AND CLEARANCE REQUIREMENTS

The figure to the right illustrates Code clearance requirements for a boiler. The gas supply enters on the left side, and requires a minimum 24 in (600 mm) service access clearance, or greater if specified on the appliance rating plate. Similar clearance is required for the front service panel. The rear clearance to the noncombustible wall will be determined by access requirements for items such as piping or wiring. Side clearance to the combustible wall is a minimum of 18 in (450 mm) (see Clause 6.1.3) or as specified on the appliance rating plate.



3.14.5 An *appliance* shall not be installed on a roof

- (a) exceeding 13 ft (4 m) in height from grade to roof elevation unless fixed access to the roof is provided; and
- (b) exceeding 26 ft (8 m) in height from grade to roof elevation unless permanent fixed access to the roof by means of either a stairway, or a stairway leading to a ladder not exceeding 13 ft (4 m) in height is provided.

3.14.6 When an *appliance* is installed on a roof

- (a) the *appliance* shall be installed on a well-drained surface. When water stands on the roof, either at the *appliance* or in the passageways to the *appliance*, or when the roof has a water seal, a suitable walkway shall be provided above the water line. Such walkway shall be located adjacent to the *appliance* and control panels so that the *appliance* can be safely serviced;
- (b) the clearance between the *appliance* and the edge of the roof or other hazard shall be at least 6 ft (2 m); and
- (c) if the *appliance* is enclosed, such *enclosure* shall permit easy entry and movement, be of reasonable height, and have at least 2 ft (600 mm) clearance to either side of the

service access panel of each *appliance* in the *enclosure*.

Intent and Rationale — Clauses 3.14.5 and 3.14.6

The intent of these Clauses is to ensure that a roof-mounted appliance is not affected by accumulated water and the installation is readily and safely accessible for inspection, maintenance, and servicing.

Roof-mounted appliance installations inherently discourage regular inspection, maintenance, and servicing; hence, ready access must be provided above heights reached using commonly available ladders. On roofs without suitable drainage, a walkway over ponded water, which can also serve as a working platform adjacent to the appliance, is required to enable access, maintenance, and servicing. Roof-mounted appliance enclosures must permit ready access to the appliance, conforming to its specific servicing characteristics.

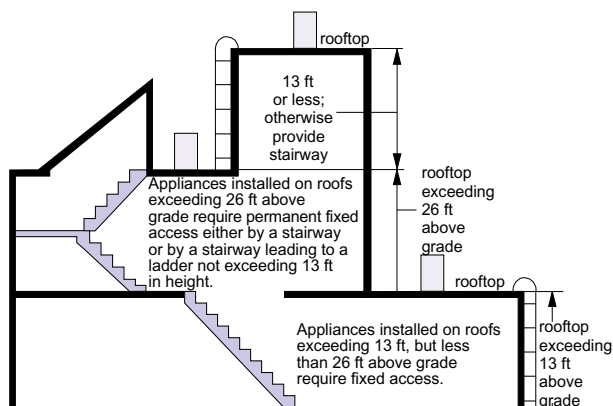
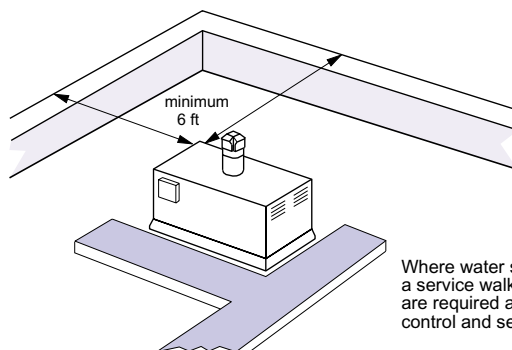
3.14.7 An *appliance* installed at a distance of 10 ft (3 m) or more from the floor, as measured from the lowest point of the *appliance*, shall be provided with either

- (a) a permanent accessible service platform which permits access to all parts of the *appliance* requiring service; or
- (b) other *approved* means of service access.

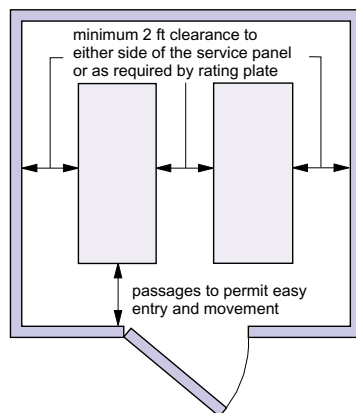
Intent and Rationale — Clause 3.14.7

The intent of Clause 3.14.7 is to provide safe access to suspended appliances for the purposes of inspection, maintenance, and servicing.

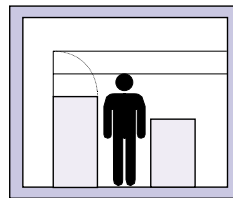
Ladders may not provide a safe or suitable means of access to appliances beyond a height of 10 ft above the floor; hence, a permanent or suitable means of service access must be provided. A permanent means of access does not necessarily mean a fixed platform. It may also consist, for example, of a forklift with an approved working platform attached to the forks, as long as the forklift is always available in the building or facility where the appliance is located. In all cases, the authority having jurisdiction over worker safety must approve the means of service access, including ladders where permitted.

ACCESS REQUIREMENTS FOR ROOF-MOUNTED APPLIANCES**UNENCLOSED ROOFTOP APPLIANCE INSTALLATION REQUIREMENTS**

Where water stands on the roof, a service walkway and platform are required adjacent to the control and service panels.

CLEARANCES TO APPLIANCES IN ENCLOSURES

Appliances within enclosures must be installed in compliance with Clause 7.2 for air supply.



Provide sufficient height for persons to access appliances and open service panels.

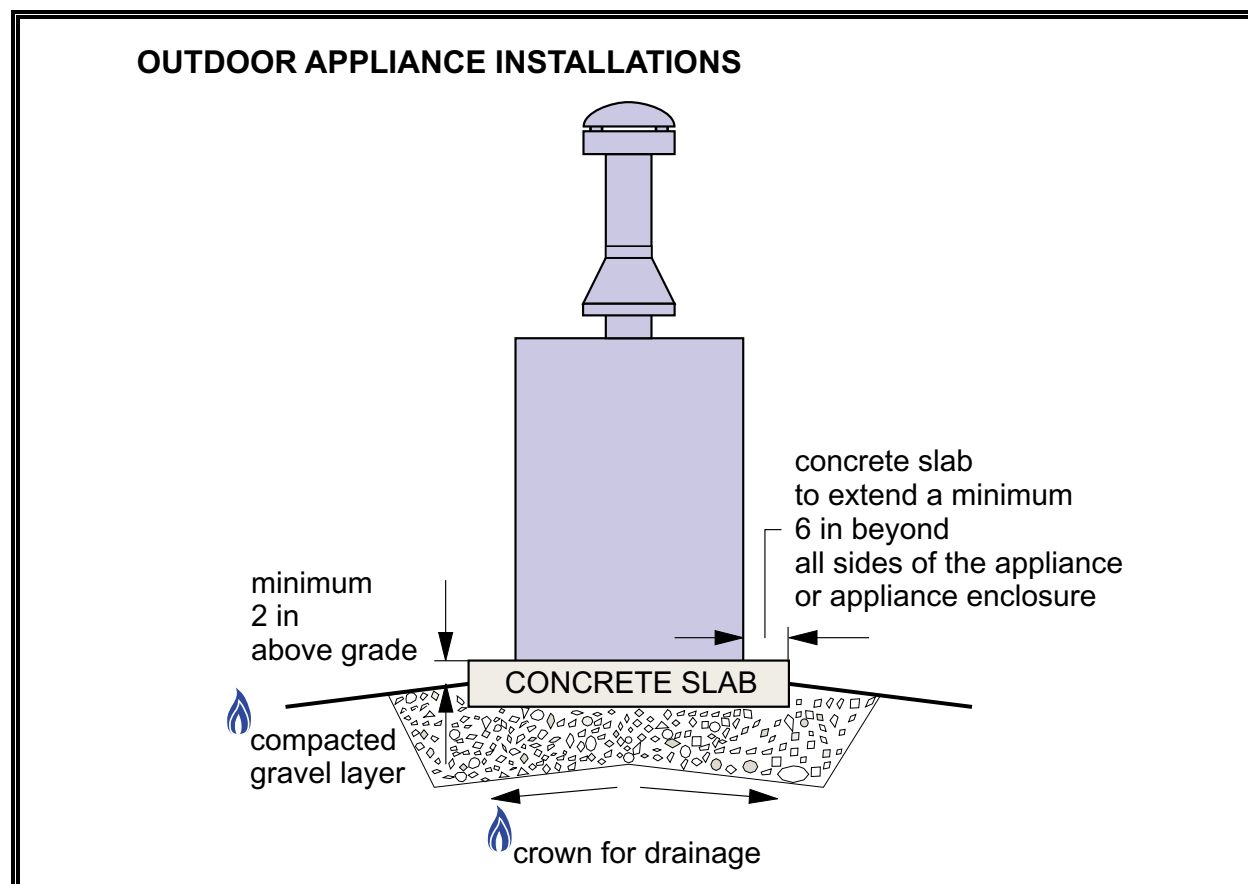
3.15 Outdoor Installations

Intent and Rationale — Clause 3.15

Clause 3.15 is intended to restrict outdoor appliance installations to approved types, prevent the location of outdoor appliances where they may interfere with the operation of other appliances, and provide stable support for outdoor appliances.

The authority having jurisdiction must approve outdoor appliance installations. This permits the authority having jurisdiction to apply judgment based on local climatic and geographic conditions, as well as past experience, to assure acceptable performance.

The location of outdoor appliances must avoid the direct circulation of flue gases into the combustion air inlet or circulating airstream of any other appliances that could impair their performance. Ground-supported, outdoor appliances must have their weight sufficiently distributed over a slab to minimize settlement, and gravel must be placed beneath the slab to provide drainage and minimize frost heave. Support movement, in addition to placing appliances out of level, may cause excessive stress on piping connections. Keeping the appliance above grade level and draining the soil beneath the slab with gravel provide protection against water damage due to surface ponding.



3.16 Appliances in Garages

Intent and Rationale — Clause 3.16

The requirements of this Clause are intended to protect appliances installed in garages against damage and to prevent the ignition of flammable vapour that may be caused by either an electrical or a mechanical component of a gas-burning appliance installed in either a storage or repair garage.

Activities taking place in garages can cause damage to appliances through mechanical impact, particulate accumulation (dust and grime), or chemical corrosion; hence, appropriate protective measures are required. The potential for flammable vapours accumulating in garages is sufficiently high to warrant placing components capable of igniting these vapours above their pooling level. Components capable of igniting flammable

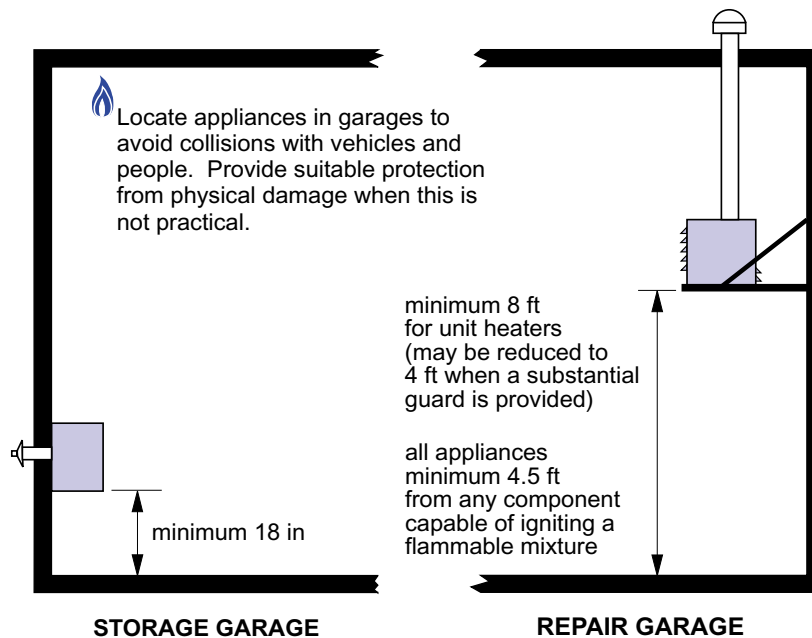
mixtures may be an open flame, a hot contact surface, or an electrical device that is not rated against arcing (sparks). In storage garages, the minimum height above floors is set lower than for repair garages, since flammable vapours are typically confined to spilled or leaking fuels. In repair garages, flammable vapours may be generated at workbench levels, thus accounting for the 3 ft difference in minimum installation heights.



Looking Ahead

Check the clearance requirements in Clause 6.26.4 when installing unit heaters in garages.

APPLIANCES IN GARAGES



3.17 Appliance Ductwork Connections

3.17 Ductwork shall not be connected to an *appliance* unless the *appliance* is approved for use with ductwork.

Intent and Rationale — Clause 3.17

The intent of Clause 3.17 is to prohibit the connection of ductwork to an appliance not approved for use with ductwork, in order to prevent malfunction or damage of the appliance.

Appliances that are not approved for use with ductwork may overheat when ductwork is connected to them. Overheating often results when an appliance cannot generate sufficient airflow to overcome the resistance of the attached ductwork. Overheating may lead to malfunction or damage of the appliance.

3.18 Combined Heating Systems

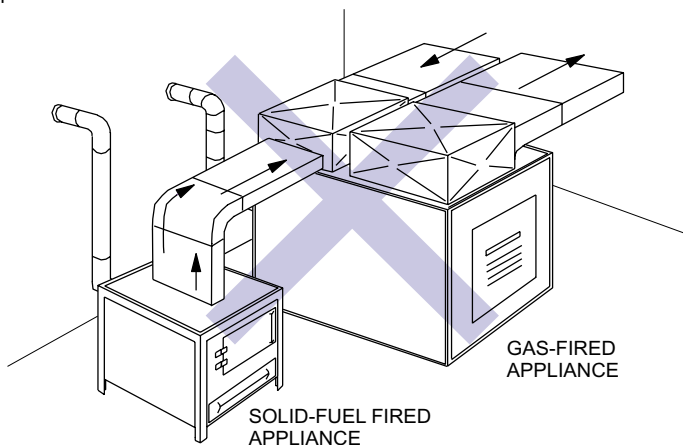
Intent and rationale — Clause 3.18

The requirements of this Clause are intended to ensure the safety of solid-fuel fired appliance installations that are integrated with gas-burning appliances.

Solid-fuel fired appliances that are not certified for combined installation with gas-burning appliances may introduce combustion products to indoor air, thereby posing a health and safety risk. They may also introduce air of a sufficiently high temperature to cause component damage in the gas appliance. All non-gas components of combined heating systems are governed by the applicable building code and/or CAN/CSA-B365-M91 (R1998), *Installation Code for Solid-Fuel Burning Appliances and Equipment*, requirements for the particular solid-fuel fired appliance or add-on furnace installed. The B149.1 Code requirements apply only to the gas-burning appliance(s) connected to the combined heating system.

PROHIBITED DUCTWORK CONNECTIONS

Connections of solid-fuel burning heating appliances to the ductwork of gas-burning appliances are not permitted.



3.19 Appliances Protected by Automatic Fire-Extinguishing Systems

Intent and Rationale — Clause 3.19

The intent of these requirements is to provide an interlocked automatic valve capable of shutting off the gas supply serving appliances protected by an automatic fire-extinguishing system, when the extinguishing system is activated. A further level of safety is achieved by providing a manual shut-off valve upstream of the automatic valve.

In the event of fire involving gas-burning appliances protected by an automatic fire-extinguishing system, activation of the fire-extinguishing system must automatically shut off the supply of gas to minimize further fire hazards. This interlocked gas supply shut-off valve must be identified, labelled, and located so as to permit easy recognition, useful instruction, and safe access. A manual shut-off valve as required in Clause 3.19.3 provides a safe means of shutting off the gas supply in the event the automatic shut-off valve fails to operate properly.

3.20 Control of Appliances with Self-Energized Pilots

Intent and Rationale — Clause 3.20

The requirements of Clause 3.20 are intended to prevent more than one appliance with a self-energizing pilot from being controlled by a single actuating device.

The rationale for this requirement is conveyed within the requirement itself.

3.21 Defective Heat Exchangers

3.21.1 Where the heat exchanger of a *furnace* installed in a *dwelling unit* is found to be defective, it shall be replaced.

3.21.2 A heat exchanger referred to in Clause 3.21.1 may be temporarily repaired if necessary, and when repaired, it shall be in accordance with procedures acceptable to the *authority having jurisdiction*.

3.21.3 Where the heat exchanger of a commercial or industrial *appliance* is found to be defective, it may be repaired, and when repaired, it shall be in accordance with procedures acceptable to the *authority having jurisdiction*.

Intent and Rationale — Clause 3.21

Clause 3.21 is intended to ensure the safety of heat exchangers due to the severe nature of the hazards associated with combustion products.

The risks and consequences associated with defective furnace heat exchangers justify stringent safety requirements, particularly when furnaces are installed in a dwelling unit. Heat exchangers in residential furnaces are not suitable for the provision of an economical and safe permanent repair. If a replacement heat exchanger is not available, then furnace replacement is mandatory; however, temporary repair to maintain heat in a dwelling while a new heat exchanger or furnace is on order is permitted, provided such repair is acceptable to the authority having jurisdiction. It is permissible to permanently repair commercial and industrial appliance heat exchangers, provided the repair complies with procedures acceptable to the authority having jurisdiction.

3.22 High Altitude Installations

3.22.1 New *appliances* with inputs up to and including 400 000 Btuh (120 kW) and *certified* for high altitude operation shall be adjusted to the high altitude rating shown on the nameplate when installed at elevations between 2000 and 4500 ft (600 and 1350 m) above sea level.

3.22.2 When an *appliance* is installed at elevations above 4500 ft (1350 m), the *certified* high altitude input rating shall be reduced at the rate of 4% for each additional 1000 ft (300 m).

Intent and Rationale — Clause 3.22

The requirements of Clause 3.22 are intended to accurately adjust the input ratings of appliances certified for high altitude to ensure proper performance.

The rated output of gas-burning appliances decreases with higher altitudes due to the reduction in atmospheric pressure. The reduction in the density of the air reduces the venting effectiveness of buoyancy vented appliances (natural draft and fan-assisted appliances). Induced or forced draft appliances and direct vent appliances are also affected by high altitudes, but not to the same extent as buoyancy vented appliances. For this reason, appliances installed at altitudes exceeding 2000 ft above sea level must be certified for this application to ensure satisfactory performance, according to CGA 2.17-M91, *Gas-Fired Appliances for Use at High Altitudes*. In the case of natural draft and fan-assisted appliances, high altitude ratings may be obtained by a change in orifice size or by a change in manifold pressure when the appliance is equipped with a gas pressure regulator. Appliances may be equipped or adjusted at the factory for the high altitude rating or may be field converted using a manifold pressure change or a certified field conversion kit. For induced or forced draft appliances and direct vent appliances, adjustments to the air supply are typically required to ensure proper high altitude performance. In all cases, appliances must be suitably marked to indicate their altitude adjusted input rating.

3.23 Protection of Appliances from Physical Damage

3.23 Where an *appliance* is installed in an area where physical damage may be incurred, the *appliance* shall be protected from such damage.

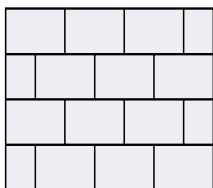
Intent and Rationale — Clause 3.23

This requirement is intended to adequately protect appliances from reasonably foreseeable physical damage.

The rationale for this requirement is to allow designers and installers to provide appropriate protection measures based on their judgment and experience. Due to the large number of protection measures available, it is not practical to specify exact Code requirements.

OPTIONS FOR PROTECTION AGAINST PHYSICAL DAMAGE

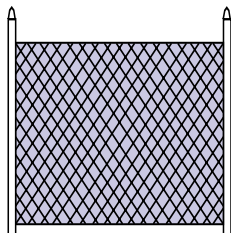
Protection of appliances from physical damage is the responsibility of the designer and/or installer. Some options are discussed below.



In environments where dust, sparks, corrosive vapours, or propelled objects may damage an appliance, a noncombustible enclosure is recommended. Refer to Clause 3.9 for hazardous appliance locations and to Clause 7 for applicable air supply requirements.



Where the factors listed above do not pose a risk, but where vehicular traffic may pass near the appliance (eg, warehouse forklift), a sturdy guard capable of withstanding normal vehicular impacts is recommended. Design the guard to permit access for maintenance and servicing.



Appliances located in areas where only minor impacts by light objects pose a risk of damage may be protected with a barrier such as a chain link fence. If a combustible barrier material is selected, ensure that clearances to combustibles are maintained.

4. PRESSURE CONTROLS

Gas pressures in supply mains and from storage tanks are generally higher than the safe operating pressures of connected appliances. For this reason, gas pressures must be controlled to fall within an appropriate range, depending on the operating characteristics of installed appliances. The requirements for pressure control in Clause 4 are intended to limit the range of gas pressure to ensure safe and reliable appliance operation.

Clause 4 requirements also give practical consideration to the safe relief of gas pressure surges, the isolation of pressure control devices using manual shut-off valves to permit servicing and replacement, and the installation of pressure controls in locations that are accessible and protect the devices from physical or chemical damage.

Many practical problems associated with the installation of pressure controls may be avoided through careful planning and design. The selection of suitable pressure controls requires that the range of inlet and outlet pressures be accurately determined. Requirements for the venting of pressure relief devices can be easily accounted for when planning piping layout and pressure control locations to minimize difficulties and cost. The provision of proper protection against physical and chemical damage is best integrated during the design stage rather than in the field. Review the materials in this chapter before planning and installing pressure controls.

Key Points

- Ensure proper pressure limits are maintained for the type of building being supplied.
- Select an appropriate pressure control for the specified range of inlet and outlet pressures, and install it in a safe and accessible location.
- Provide a manual shut-off valve immediately upstream of all pressure controls to permit isolation, servicing, and replacement.
- Design and install proper venting for all required pressure relief devices.

4. PRESSURE CONTROLS

4.1 Pressure Inside Buildings

Intent and Rationale — Clause 4.1

The requirements of Clause 4.1 are intended to limit gas pressures in buildings to acceptable levels and to provide general requirements for pressure regulator locations and specific requirements for system regulators.

Gas pressures inside of buildings are limited according to the type of building in order to minimize the need for appliance pressure regulators and pressure relief devices.

Table 4.1.1 indicates the maximum permissible pressures in buildings. Higher gas pressures are allowed in central boiler and mechanical rooms than in other areas of hotels, motels, and multi-unit housing, since the risk associated with gas leakage is isolated from occupied parts of the building. A similar rationale applies to boiler or mechanical rooms located on the roof of commercial buildings. Gas pressures may only rise above the pressures listed in the table if an engineering assessment complying with nationally recognized standards or test requirements is provided.

System regulators must be capable of being isolated for servicing or replacement; hence, a manual shut-off valve must be installed upstream of the regulator. The system regulator must be provided with either an internal relief device or a line relief device that is capable of relieving excess gas pressure to the outdoors. The requirement for venting relieved natural gas to the outdoors does not apply to regulators serving low pressure systems when a relief device of a limited flow is provided according to Clause 4.1.4 (also refer to Clause 4.2.7). (Similar exemptions are available under Clause 4.5.2 for both natural gas and propane.) This rate of gas leakage (bleeding) is viewed as having an extremely low likelihood of generating dangerous concentrations of gas.

General installation requirements for all pressure regulators include accessibility and protection against physical or chemical damage. These requirements recognize the importance of maintaining the good operating condition of this equipment.



Looking Ahead

Refer to Flexible Copper Tubing Systems in **5. Piping and Tubing Systems, Hose, and Fittings** of this handbook to determine whether a conventional natural gas pressure system (7 in w.c.) or a 2 psig system is best suited to your residential installations.

Table 4.1.1 Pressure inside Buildings		
Type of building	Maximum pressure, psig (kPa)	
	Other than central boiler or mechanical room	Central boiler or mechanical room
One- and two-family dwellings and row housing	2 (14)	—
Hotels and motels	5 (35)	20 (140)
Residential , other than one- and two-family dwellings and row housing	5 (35)	20 (140)
Institutional and Assembly	5 (35)	20 (140)
Commercial	20 (140)	20 (140)*†
Industrial	66 (450) NG 20 (140) P	66 (450) NG 20 (140) P
Central heating plants	—	66 (450) NG 20 (140) P
For Propane Only:		
Building under construction (construction heater application)	25 (175)	25 (175)
* 20 psig (140 kPa) is permissible in boiler or mechanical rooms located on the roof of commercial buildings for propane.		
† 66 psig (450 kPa) is permissible in boiler or mechanical rooms located on the roof of commercial buildings for natural gas.		

EQUIVALENTS FOR COMMONLY REFERENCED PRESSURES		
lb per in ² gauge (psig)	kilopascals (kPa)	inches water column* (in w.c.)
0.018	0.125	0.5
0.036	0.25	1
0.25	1.75	7
0.5	3.5	14
1	7	28
1.5	10	42
2	14	56
2.5	17	70
5	35	140
10	70	280
20	140	560
* It is generally not practical to measure in w.c. beyond 14 in the field.		

4.2 Pressure Regulators

Intent and Rationale — Clause 4.2

The intent of this Clause is to ensure that pressure regulators are sufficiently sized and properly located so as to prevent the impairment of their performance.

Gas pressures will vary over time in every supply system. This range of pressures must be considered when selecting and sizing a pressure regulator, in order to ensure that the required flow rate is delivered both at the minimum and maximum supply pressures. The range of supply pressures may be obtained from the gas utility or distributor. The engineering data supplied with regulators may then be used to make an appropriate selection. Regulators must not be located in a position that would allow moisture from clothes dryers, appliance vents, or any other source of moisture to condense and freeze on the regulator and, in particular, the regulator vent. The buildup of ice may impair the proper performance of the regulator and lead to serious problems.

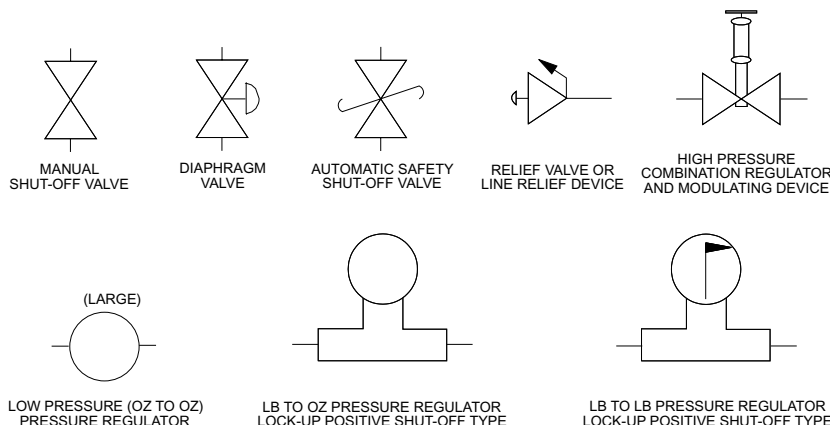
Further, system regulators must not be bypassed; otherwise, the pressure of gas in the building will not be properly controlled within allowable limits.



Looking Ahead

Clauses 6.4.3 and 6.5.2 require that the moisture exhaust ducts from commercial and domestic clothes dryers not terminate within 3 ft (1 m) of any service regulator. Also refer to Clause 7.14.8 for vent termination requirements in relation to service regulators and regulator vents.

COMMON VALVE AND PRESSURE CONTROL SYMBOLS



FOR A MORE COMPLETE LISTING OF GRAPHICAL SYMBOLS FOR PIPE FITTINGS, VALVES, AND PRESSURE CONTROLS REFER TO:

CSA B149.3-00, *Code for the Field Approval of Fuel-Related Components on Appliances and Equipment*; and
 ASA Z32.2.3-1949, *Graphical Symbols for Pipe Fittings, Valves, and Piping*.

Intent and Rationale — Clauses 4.2.6 to 4.2.8

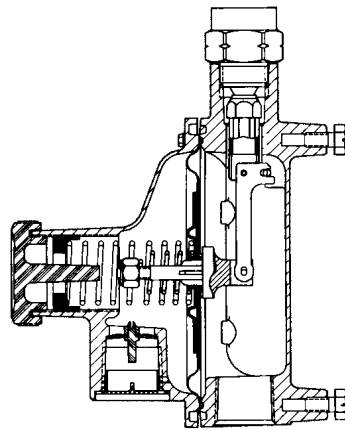
The intent of these Clauses is to provide general safety requirements for system regulators in the proximity to appliances.

System regulators must not be bypassed, except with the approval of the authority having jurisdiction. In some cases, particularly large-scale industrial installations, it may be desirable to bypass the system regulator and second-stage regulators in order to avoid complete shutdown of the operations. Permission may be obtained from the authority having jurisdiction provided a reasonable level of safety is maintained for the duration of the repair or replacement procedure.

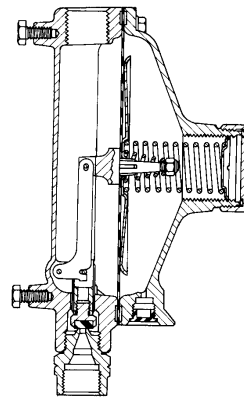
The requirement for venting relieved natural gas to the outdoors does not apply to system regulators equipped with a relief device limited to a flow of 1 ft³ per h (0.0283 m³ per h) of a gas having a relative density of 0.6 at 7 in w.c. (1.74 kPa). This rate of gas leakage is viewed as having an extremely low likelihood of generating dangerous concentrations of natural gas indoors. Propane, being heavier than air, does not permit the application of this requirement since it may pool in dangerous concentrations at floor level.

When the inlet pressure to a system regulator exceeds 0.5 psig (3.5 kPa), it must be of the positive shut-off type. This requirement ensures that high pressure surges will shut off flow downstream of the system regulator to prevent damage to connected equipment or accessories.

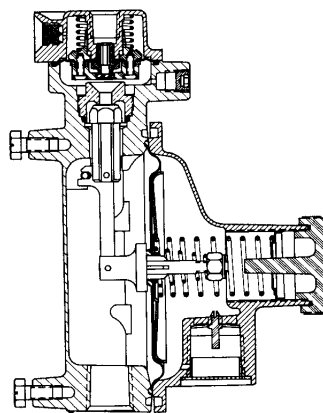
EXAMPLES OF PROPANE REGULATORS



HIGH PRESSURE
FIRST STAGE REGULATOR

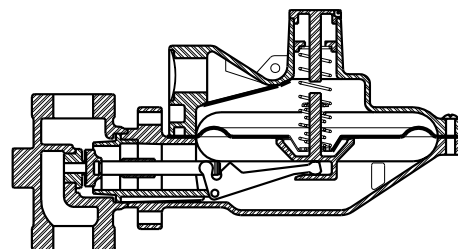
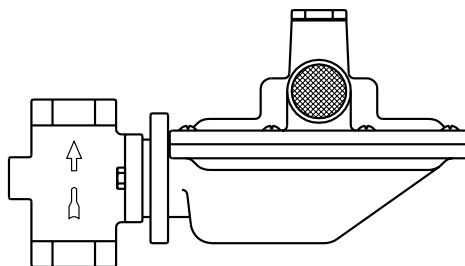


LOW PRESSURE
SECOND STAGE REGULATOR



HIGH TO LOW PRESSURE
TWIN STAGE REGULATOR

EXAMPLE OF NATURAL GAS REGULATOR



4.3 Line Relief Devices

Intent and Rationale — Clause 4.3

The requirements of Clause 4.3 are intended to specify the operating characteristics of line relief devices.

The operating characteristics of internal relief devices in system regulators are governed by the standards under which they are certified. When a separate line relief device is provided, the same operating characteristics specified in these standards must be satisfied. A line relief device must be capable of withstanding normal gas supply pressure fluctuations without discharging, but it must discharge when pressures exceed the upper range of normal pressure fluctuations. At the same time, the pressure setting must not be higher than the lowest rated component or accessory downstream of the line relief device, since overpressure may result in erratic operation, leakage, or complete malfunction of the component or accessory.

NOTE ON PRESSURE RELIEF DEVICES AND VENTING

Except for pressure relief devices that limit the flow of gas to no more than 1 ft³ per h (0.0283 m³ per h), every pressure relief device must be vented to the outdoors. The methods for sizing individual and combined vent lines specified in the Code are based on a rule-of-thumb approach. Manufacturer's instructions or engineering data sheets may be used for vent sizing and installation, subject to the approval of the authority having jurisdiction. The following are key considerations in the venting of pressure relief devices:

- **plan the location of pressure relief devices to simplify the layout and installation of vent lines;**
- **properly size individual and combined vent lines;**

- **terminate vent lines in a safe and suitable location; and**
- **provide proper protection for vent line terminations against physical damage, the weather, and insects.**

Always consult with the authority having jurisdiction regarding unusual vent line configurations and terminations.

4.4 Hydrostatic Relief Devices

Intent and Rationale — Clause 4.4

The requirements of Clause 4.4 apply only to propane and are intended to provide appropriate hydrostatic pressure relief for propane liquid piping between each pair of shut-off valves; the Clause also requires the safe discharge of relief lines serving such devices.

When liquid propane is trapped in piping or hose between two closed valves, it will expand as it absorbs heat from its surroundings. The resulting pressure may exceed the capacity of the piping or hose, causing it to burst. For this reason, a hydrostatic relief device must be installed between each pair of valves. The start-to-discharge pressure setting range, specified in the requirements, avoids discharge due to normal pressure fluctuations and prevents the rupture of piping, hose, or fittings, while accounting for deterioration in their pressure capacity due to exposure and wear.

4.5 Venting of Pressure Control Devices

- Δ **4.5.1** Except as specified in Clauses 4.5.2, 4.5.3, and 4.5.4 for natural gas and Clauses 4.5.2, 4.5.4, and 4.5.11 for propane, when an automatic *valve*, diaphragm *valve*, combination control, *pressure regulator* without internal relief, or other control device (excluding a gas overpressure relief *valve*) that requires venting is installed, it shall be vented separately to a safe location outdoors, by a *vent* line

- (a) of steel pipe, copper, seamless aluminum or steel tubing that complies with Clause 5.2; and
- (b) of a size at least equal to the nominal pipe size of the **vent** outlet of the **valve**, combination control, **pressure regulator**, or control device, but in no case shall the inside diameter be less than 0.25 in (6 mm).

Intent and Rationale — Clause 4.5.1

The requirements of Clause 4.5.1 are intended to specify the safe venting to the outdoors of relieved gas from pressure control devices, excluding overpressure relief valves and pressure regulators with internal relief devices.

Gas relieved by pressure control devices must be safely vented to the outdoors to prevent the accumulation of dangerous concentrations of gas indoors. Vent lines must be constructed of the same piping or tubing materials required for the supply of gas and propane in Clause 5.2. The size of the vent line must be at least that of the nominal pipe size of the vent outlet of the control device. A vent line must not have an inside diameter less than 0.25 in (6 mm), since small vent lines may cause impedance of the control device operation.

Note: While no specific procedure for sizing vent lines is provided in the B149.1 Code, it is suggested that the regulator/relief valve manufacturer's instructions or engineering data sheets be used for vent sizing and installation.

- Δ **4.5.2 For Natural Gas:** When an **appliance pressure regulator** without internal relief having a diaphragm not in excess of 6 in (150 mm) in diameter and an inlet pressure not in excess of 2 psig (14 kPa) is installed on an **appliance**, it may be constructed or equipped with a device to limit the escape of gas from the **vent** opening in the event of diaphragm failure, and the opening in the device shall restrict the escape of gas to not more than 1 ft³ (0.0283 m³) per hour of a gas having a specific gravity of 0.6.
- Δ **For Propane:** When an **appliance pressure regulator** without internal relief having a diaphragm not in excess of 6 in (150 mm) in

diameter and an inlet pressure not in excess of 2 psig (14 kPa) is installed on an **appliance**, it shall be vented to the outdoors unless it is constructed or equipped with a device to limit the escape of gas from the **vent** opening in the event of diaphragm failure, and the opening in the device shall restrict the escape of gas to not more than 1 ft³ (0.0283 m³) per hour of a gas having a specific gravity of 1.53. A regulator with a vent limiting means shall only be installed in a ventilated location.

Intent and Rationale — Clause 4.5.2

The requirements of Clause 4.5.2 are intended to permit the relief of acceptably small amounts of gas to the indoors from appliance pressure regulators with low inlet pressures.

The requirement for venting relieved gas to the outdoors does not apply to appliance regulators with low inlet pressures when a relief device limited to a flow of up to 1 ft³ per h (0.0283 m³ per h) is provided. This rate of gas leakage is viewed as having an extremely low likelihood of generating dangerous concentrations of gas indoors.

IMPORTANT NOTE: Because propane is heavier than air, this requirement is limited to ventilated locations where the propane gas may be sufficiently diluted to avoid dangerous concentrations. Always check with the authority having jurisdiction to ensure sufficient ventilation is available to the appliance pressure regulator.

4.5.3 For Natural Gas Only: When a diaphragm **valve** or combination control is installed on an **appliance** with an inlet supply pressure not in excess of 0.5 psig (3.5 kPa) and using a gas lighter than air, it may be vented into the **appliance** combustion chamber adjacent to the **continuous pilot**, and the terminus of the **bleed vent** shall be in a **burner** tip having a melting point in excess of 1450 °F (790 °C), securely held in a fixed position relative to the **pilot** flame, and shall not adversely affect the operation of the thermal element.

Intent and Rationale — Clause 4.5.3

Clause 4.5.3 is intended to permit the venting of lighter than air gas discharged from appliance diaphragm valves or combination control devices with low inlet pressures to the combustion chamber of appliances with continuous pilots.

The quantity of gas discharged from appliance diaphragm valves or combination control devices with low inlet pressures is sufficiently small to permit venting to the appliance combustion chamber. The appliance must have a continuous pilot in order to ignite the discharged gas and vent the by-products to the outdoors. The bleed vent line permitted in this case must terminate in a fixed position relative to the pilot flame; the line must be in a position where it will not melt or deteriorate under exposure to heat, and it must be appropriately fixed in a manner that does not impair the operation of the appliance.

4.5.4 When two or more or any combination of automatic *valves*, diaphragm *valves*, combination controls, other control devices (excluding gas overpressure relief *valves*) or *pressure regulators* without internal relief that require venting are installed, they may be connected into a single *vent*, provided that

- (a) there is compliance with
 - (i) Clause 4.5.1(a) and (b) for inlet pressure not in excess of 0.5 psig (3.5 kPa); or
 - (ii) there is compliance with Clause 4.5.5(a) and (b) for inlet pressure in excess of 0.5 psig (3.5 kPa); and
- (b) the single *vent* line has an area of not less than twice the total area of the connected bleed *vents*.

**Better Practice**

An engineering method approved by the authority having jurisdiction for the sizing of common vent lines may significantly reduce the cost of piping or tubing, while making it less obtrusive, when a large number of relief devices require common venting.

Intent and Rationale — Clause 4.5.4

The requirements of Clause 4.5.4 apply to pressure control devices other than overpressure relief valves or pressure regulators with internal relief, and are intended to permit the connection of individual vent lines into a single vent line.

Provided the individual requirements for the venting of each pressure control device are satisfied, the individual vents may be connected to a single vent. The sizing of the single vent line is based on a rule-of-thumb that requires it to be twice the area of the total area of the connected bleed vents.

4.5.5 Except as specified in Clause 4.5.6, when a gas overpressure relief *valve* or a *pressure regulator* with internal relief is installed, it shall be vented separately to a safe location outdoors by a *vent* line

- (a) of steel pipe, copper, or seamless steel tubing that complies with Clause 5.2; and
- (b) of a size at least equal to the nominal pipe size of the *vent* outlet of the *valve* or *regulator*, and
 - (i) increased as specified by the manufacturer's instructions; or
 - (ii) in the absence of manufacturer's instructions, increased by one pipe size diameter for every 50 ft (15 m) or part thereof that the *vent* line extends beyond the initial 50 ft (15 m). This increase shall be made at the connection on the device.

Intent and Rationale — Clause 4.5.5

The requirements of Clause 4.5.5 apply to overpressure relief valves and pressure regulators with internal relief devices, and are intended to specify the means of safely venting relieved gas to the outdoors.

Gas relieved by pressure control devices must be safely vented to the outdoors to prevent the accumulation of dangerous concentrations of gas indoors. Vent lines must be constructed of the same piping or tubing materials required for the supply of gas and propane outlined in Clause 5.2. The size of the vent line must be at least that of the nominal pipe size of the vent outlet of the control device. Its size must then be increased either as specified by the device manufacturer or according to the rule-of-thumb noted in Clause 4.5.5(b)(ii).

4.5.6 When two or more gas overpressure **relief devices** are installed, they may be connected into a single **vent** line, provided that

- (a) there is compliance with Clause 4.5.5(a) and (b);
- (b) the single **vent** line has an area equal to the largest **relief device** or pressure **regulator** opening plus 50% of the total area of the other **relief device** openings;
- (c) the variance between the inlet pressure of the overpressure relief **valves** does not exceed 10%; and
- (d) the variance between the outlet pressures of the overpressure relief **valves** does not exceed 10%.

Intent and Rationale — Clause 4.5.6

The requirements of Clause 4.5.6 apply to overpressure relief valves or pressure regulators with internal relief devices, and are intended to permit the connection of individual vent lines into a single vent line.

Provided the individual requirements for the venting of each pressure control device are satisfied, the individual vents may be connected to a single vent. The sizing of the single vent line is based on a rule-of-thumb that determines the minimum required size on the basis of the likelihood of all of the relief devices discharging simultaneously. This simplified means of sizing the common vent is only permitted when the variance between the inlet pressures and the variance between the outlet pressures of the overpressure relief valves are within 10%.

4.5.7 The outdoor **vent** termination of **regulators** and line **relief devices** shall be equipped with a means to prevent the entry of water, insects, or foreign material.

4.5.8 A **vent** line shall be of size sufficient to prevent impedance upon a **regulator** or shall be equipped with a **regulator** suppressor assembly.

4.5.9 A safety limit or a safety **relief device** shall not be isolated, bypassed, or in any way made ineffective by a **valve** or other device.

Δ **4.5.10** The discharge from **relief devices** shall terminate outdoors with the clearances specified in Table 4.5.10.

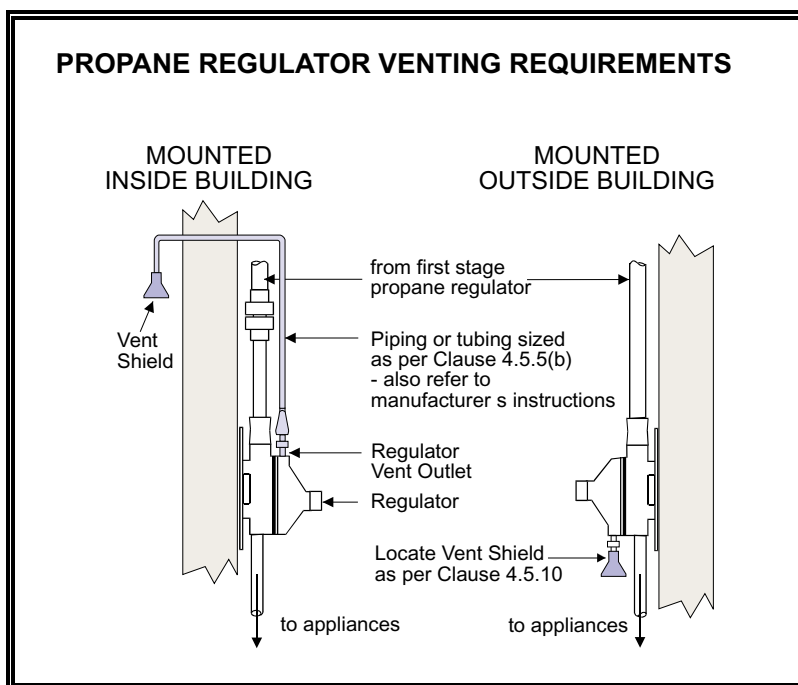
Intent and Rationale — Clauses 4.5.7 to 4.5.10

The requirements of Clauses 4.5.7 to 4.5.10 are general in nature, and intended to ensure the suitable location and protection of outdoor vent terminations, the minimization of vent line interference with regulator performance, and the prevention of the bypassing or isolation of safety limit or relief devices.

The rationale for Clauses 4.5.7 to 4.5.10 is conveyed within the requirements themselves.

Table 4.5.10
Clearance from Discharge, ft (m)

	Relief capacity		
	Natural gas up to and including 1900 scf/h (55 m ³ /h)	Natural gas over 1900 scf/h (55 m ³ /h)	Propane
Building opening	3 (1)	10 (3)	3 (1)
Appliance vent outlet	3 (1)	3 (1)	3 (1)
Mechanical air intake	10 (3)	10 (3)	10 (3)
Appliance air intake	3 (1)	10 (3)	10 (3)
Source of ignition	3 (1)	3 (1)	10 (3)



5. PIPING AND TUBING SYSTEMS, HOSE, AND FITTINGS

Clause 5 of the B149.1 Installation Code provides requirements for piping and tubing systems, hose, and fittings. These requirements represent conventional industry practice, and it should be noted that a large number of new technologies and systems are constantly entering the marketplace. For such proprietary products, manufacturer's certified installation instructions serve as additional requirements to those found in Clause 5.

The scope of Clause 5 deals primarily with gas piping and tubing, and hose from the meter into all of the appliances served and between buildings. Gas piping from the main supply to the meter is normally handled by the gas utility; however, the fundamental principles of this Clause are generally applicable.

Piping and tubing systems, as well as hose, must incorporate sound and approved materials that are properly sized, located, and protected. All piping outlets, drip pockets, and valves must be installed as required. The entire system must be properly pressure tested and purged, and then appropriately identified.

By following the Code and applying sound trade practice, a safe and reliable supply of gas can be delivered and maintained.

Key Points

- Select, design, and install the appropriate piping or tubing, system needed to serve the connected appliances.
- Adhere to all Code requirements and check with the authority having jurisdiction for additional, specific requirements, especially for unusual cases.
- Always check the manufacturer's certified installation instructions against Code requirements.
- Properly pressure test and purge the system.
- Ensure the piping system is adequately supported, protected, and identified.

OVERVIEW ON PIPING, TUBING, AND HOSE SYSTEMS

BASIC REVIEW CHECKLIST

The items listed below should be checked to ensure that the basic requirements for piping, tubing, and hose systems have been met.

- sound and approved materials and fittings suitable for their intended use
- appropriate location underground, aboveground, and concealed, with proper protection
- adequate sizing for existing and known future appliances, using the correct gas volume and allowable pressure and pressure drop
- handling and assembly in accordance with approved trade practices
- proper joints, connections, piping outlets, and drip pockets; avoid all prohibited practices
- provision of required valves
- secure support of piping and allowance for expansion and contraction
- complete pressure testing of the system
- safe purging of the system after testing
- proper identification of the entire gas supply system
- special requirement for emergency generators and rooftop installations

Gas piping, tubing, and hose systems represent the vital link from the main gas supply to gas appliances. Since the time gas was introduced in Canada, piping, tubing, and hose technology has evolved from the use of primarily black steel piping to a broad range of approved products and proprietary systems.

This overview of piping principles applies to all piping starting from the meter set, or primary regulator, and including all piping within and between buildings or appliances.

The principles of piping, tubing, and hose systems may be divided into three categories:

- health and safety
- performance
- special requirements

Under the health and safety category, installers must ensure that gas supply systems are sound, by using approved materials and fittings appropriate for their intended use. Piping, tubing, and hosing must be suitably located to prevent accidental leaks or ruptures, and to permit inspection and normal maintenance. The system must be correctly assembled, incorporating proper joints, connections, outlets, and drip pockets. All required valves must be provided. Further, the system must be fully tested, safely purged, and suitably identified. When these principles are observed, all concerns for health and safety will have been satisfied.

Gas supply systems must also meet performance requirements to ensure an adequate supply of gas to all appliances. This is accomplished through the proper sizing of the piping, tubing, and hose sections forming the system. Sizing for typical installations may be performed using tables and methods found in Appendix A of the Code, and, for more complicated arrangements and applications, it may be engineered.

Special requirements for applications such as emergency generators and rooftop gas piping and tubing must also be considered when these cases are encountered.

These basic principles have been summarized as a checklist in the box on the left. Ensure that each applicable item has been accounted for when designing and installing gas supply systems.

5. PIPING AND TUBING SYSTEMS, HOSE, AND FITTINGS

5.1 General

Intent and Rationale — Clause 5.1

This Clause is intended to provide general requirements for piping, tubing, and hose systems, including appropriate criteria and procedures for their reuse.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.

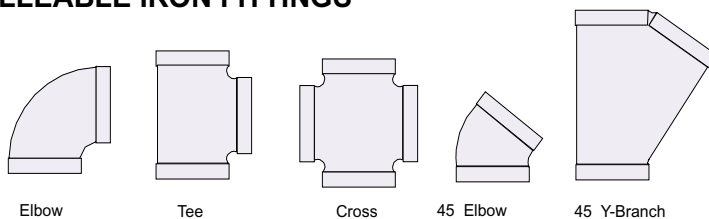
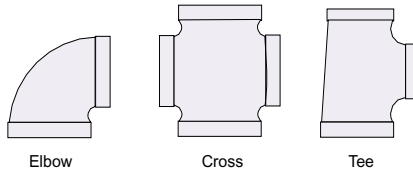
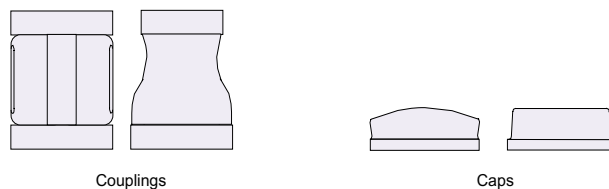
5.2 Material

Intent and Rationale — Clause 5.2

Clause 5.2 is intended to define the requirements governing piping, tubing, and hose materials.

The rationale for the requirements of this Clause is conveyed and referenced within the requirements themselves.

PIPING, TUBING, AND HOSE MATERIALS		
Requirements for piping materials in the B149.1 Code are based on proven past performance and approved testing methods. Piping must be generally capable of withstanding the pressure of the gas it conveys, and be durable under its conditions of exposure. Additional requirements may also address specific piping applications. Code requirements are intended to restrict the use of piping materials to those meeting the applicable performance levels for safe and reliable service. A brief description of the allowable piping materials is provided below.		
TYPE	DESCRIPTION AND APPLICATION	FITTINGS
Black Steel Piping	Black steel piping represents the most common material in use. Generally used in above grade applications, it may be installed underground provided it is suitably protected against corrosion by a method acceptable to the authority having jurisdiction. Black steel piping must conform to ASTM A 53 specifications. For operating pressures up to and including 125 psig (860 kPa), at least Schedule 40 piping must be used. Operating pressures exceeding 125 psig must use at least Schedule 80 piping if joints are either threaded or back welded, or at least Schedule 40 if joints are either welded, or welded and flanged.	Only malleable iron or steel fittings conforming with ANSI B16.3 may be used with black steel piping. Two classes of fittings are manufactured: Class 150 and Class 300. The Class 150 fittings may always be used for gas operating pressures up to and including 125 psig, and under normal temperatures can withstand up to 300 psig (2070 kPa). Class 300 fittings have a minimum pressure capacity of 300 psig at extreme temperatures, and may be required for high pressure applications. All Class 300 fittings are identified with the numerals "300" and letters "MI" to designate malleable iron.
Hot-Dipped, Zinc-Coated Steel Piping	Hot-dipped, zinc-coated, welded, and seamless steel piping is permitted, but is not commonly used. It is generally installed underground since it is protected against corrosion. Hot-dipped, zinc-coated, welded, and seamless steel piping must conform to ASTM A 53 specifications. The hot-dipped coating may be in any grade of zinc conforming to Specification B6. For operating pressures up to and including 125 psig (860 kPa), at least Schedule 40 piping must be used. Operating pressures exceeding 125 psig must use at least Schedule 80 piping. Welded, or welded and flanged joints are not recommended.	Only zinc-coated malleable iron or steel fittings conforming with ANSI B16.3 may be used with hot-dipped, zinc-coated, welded, and seamless steel piping. The classes of fittings are the same as those for black steel pipe fittings; however, they must be zinc-coated. Hot dipped zinc-coatings must comply with ASTM A 153, while electrodeposited zinc coatings must conform with ASTM B 633 Type I, Service Condition 4.
Copper Tubing	Copper tubing is available in a number of grades. Type G copper tubing must conform to ASTM B 837. Types K and L tubing must meet the ASTM B 88 Standard. All of these types may be used above ground provided they do not exceed 1-1/4 inch nominal size. Only Type L, externally coated with extruded PVC resin at the time of manufacture, and Type K copper tubing may be used underground. Copper tubing should always be checked to ensure its grade and allowable operating pressure.	Tube fittings are manufactured to a number of acceptable standards. It is important to check the pressure rating of tube fittings, since the B149.1 Code requires a minimum rating of 125 psig (860 kPa) for operating pressures up to this limit, and a minimum rating of 250 psig (1725 kPa) for operating pressures exceeding 125 psig. In no case shall a fitting be rated for less than the operating pressure of the gas it conveys.
Steel Tubing	Steel tubing is not commonly used in gas supply. Seamless steel tubing must comply with the ASTM A 179 Standard.	Fittings for steel tubing must be suitable for the application and rated for the operating pressure.
Plastic Piping	Plastic piping, tubing, and fittings may only be used underground. The puncture and flammability resistance of plastic piping do not permit above ground use. All plastic piping must comply with CSA B137.4.	Transition fittings from plastic to copper or steel must occur below grade, since the use of plastic piping, tubing, and fittings is restricted to underground applications.
Hose	The use of hose is highly restricted due to its low puncture resistance and melting point. All hose and hose fittings must comply with CAN/CGA-8.1 or CAN1-8.3, and be rated for a minimum working pressure of 350 psig (2400 kPa).	Ensure that only hose fittings supplied or listed by the hose manufacturer are used. Always check that pressure ratings meet or exceed the system operating pressure.
Cutting/Welding Systems	Hose used in cutting/welding systems is typically a proprietary product specified by the cutting/welding system manufacturer. All hose must comply with CSA W117.2.	All hose connections must also comply with the CSA W117.2 standard.
Other Types	A growing number of certified piping and tubing systems are available for various gas supply applications. Their use is governed by Clause 5.2.11 of the B149.1 Code, which requires these proprietary systems to be certified to a nationally recognized standard and acceptable to the authority having jurisdiction.	Due to the certification of proprietary gas supply systems, only manufacturer's certified fittings may be used. Ensure that the pressure ratings of fittings meet or exceed gas operating pressures.

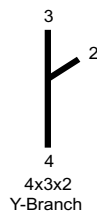
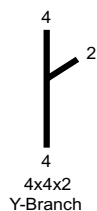
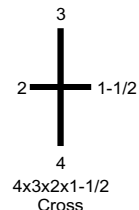
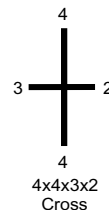
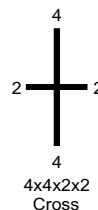
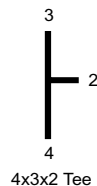
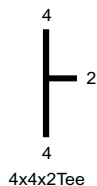
MALLEABLE IRON FITTINGS**STRAIGHT FITTINGS****REDUCING FITTINGS****COUPLINGS AND CAPS****STREET FITTINGS
(NOT PERMITTED, see Clause 5.14.7.)****FITTINGS NOMENCLATURE**

For reducing tees, crosses, and Y-branches (laterals) the size of the largest run opening shall be given first followed by the size of the opening at the opposite end of the run.

Where the fitting is a tee or Y-branch, the size of the outlet is given last.

Where the fitting is a cross, the largest side-outlet opening is the third dimension given, followed by the opening opposite.

The accompanying figures indicate how these types of fittings are identified.



5.3 Size

Intent and Rationale — Clause 5.3

Clause 5.3 is intended to provide both general and specific requirements for the sizing of piping, tubing, and hose systems. The requirements are intended to provide sufficient flexibility in attaining the performance stated in Clause 5.3.1.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.

Table 5.3.2
Maximum Allowable Pressure Drop
(See Clause 5.3.2.)

Piping and tubing system supply pressure		Maximum allowable pressure drop
Natural gas	less than 7 in w.c. (1.75 kPa)	0.5 in w.c. (0.125 kPa)
Natural gas/propane	7 in w.c. (1.75 kPa) up to 14 in w.c. (3.5 kPa)	1 in w.c. (0.25 kPa)

DIMENSIONS FOR COPPER TUBING
INCLUDING COMPARISON WITH SCHEDULE 40 PIPE

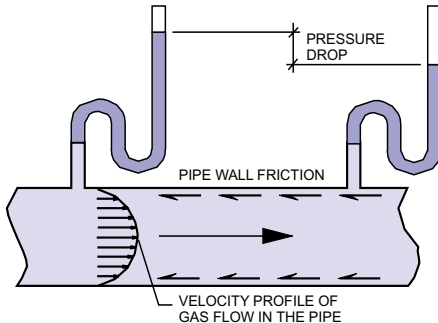
Nominal Tubing Size	Outside Diameter in (mm)	Inside Diameter Schedule 40 Pipe in (mm)	Inside Diameter in (mm)		Wall Thickness in (mm)	
			K	L	K	L
1/4	3/8 (10)	—	0.305 (7.7)	0.315 (8.0)	0.035 (0.9)	0.030 (0.8)
3/8	1/2 (13)	0.493 (12.5)	0.402 (10.2)	0.430 (10.9)	0.049 (1.2)	0.035 (0.9)
1/2	5/8 (16)	0.622 (15.8)	0.527 (13.4)	0.545 (13.8)	0.049 (1.2)	0.040 (1.0)
5/8	3/4 (19)	—	0.652 (16.6)	0.666 (16.9)	0.049 (1.2)	0.042 (1.1)
3/4	7/8 (22)	0.824 (20.9)	0.745 (18.9)	0.785 (19.9)	0.065 (1.7)	0.045 (1.2)
1	1-1/8 (29)	1.049 (26.6)	0.995 (25.3)	1.025 (26.0)	0.065 (1.7)	0.050 (1.3)
1-1/4	1-3/8 (35)	1.380 (35.1)	1.245 (31.6)	1.265 (32.1)	0.065 (1.7)	0.055 (1.4)

SIZING PRINCIPLES FOR PIPING, TUBING, AND HOSE

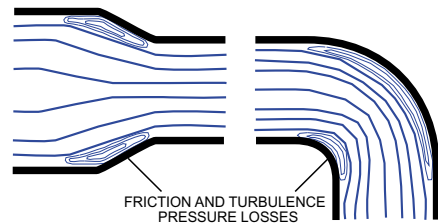
SIZING FOR ALLOWABLE PRESSURE DROP

The effects of pipe friction and fitting losses cause a pressure drop which must be accounted for in pipe sizing.

PRESSURE LOSS DUE TO PIPE FRICTION



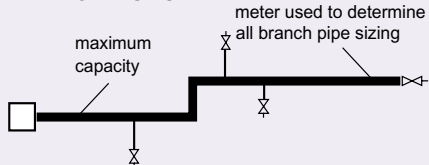
PRESSURE LOSS DUE TO FITTINGS



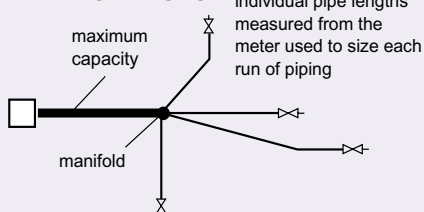
MAXIMUM CAPACITY AND PIPING CONFIGURATION

Pipe sizing must also consider the maximum capacity of the system and the piping configuration.

BRANCH RUNS



INDIVIDUAL RUNS



The sizing of gas piping, tubing, and hose is intended to provide enough gas at adequate pressure to the appliance(s) being supplied. The factors affecting pipe sizing are as follows:

- length and internal roughness of pipe
- number of fittings and valves
- supply pressure and allowable pressure drop
- maximum gas flow (demand)
- configuration of the piping system

The longer and internally rougher the pipe, the larger its required size. Increasing the pipe size compensates for the pressure loss associated with friction, because the wall surface area (source of friction) is reduced in proportion to the cross-sectional area of the pipe, as its diameter increases. Similarly, the larger the number of fittings and valves, the larger the required pipe size to offset the friction and turbulence pressure losses associated with fittings.

Pipe size is also affected by the allowable pressure drop between the meter/regulator and the appliance. The smaller the allowable pressure drop, the larger the pipe size required. The allowable pressure drop is determined by the inlet pressure and the minimum operating pressure required for the proper operation of the appliance being supplied.

The maximum gas consumption by an appliance or an entire supply system directly determines the pipe size required. As well, the configuration of the piping system affects the size of piping depending on whether branch runs or individual runs are used. In the case of branch runs, the size of each branch will depend on the capacity of the branches it serves. For individual runs, the size of each branch is determined by the capacity of the single appliance it serves. In both types of configurations, the size of the main branch is based on the total capacity or consumption of the installed appliances.

When sizing piping in practice, the approach used is based on fundamental fluid mechanics. For a given type and length of pipe, gas flow rate, and allowable pressure drop, the required pipe size may either be determined using the tables or calculated using the method found in Appendix A of the Code. When individual runs are used, the length of each run and its capacity are used for sizing. When branch runs are used, the length of the longest branch is used to size all of the branches, along with the total flow supplied by the branch. The reason for using the longest run is that if the required flow in the longest run of piping is satisfied, then the flow in all of the remaining branches will also be satisfied. The path of most resistance always determines the size of each run in a branch piping system.

Refer to the examples at the end of this chapter for typical applications.

DIMENSIONS FOR PLAIN END BLACK PIPE Obtained from the Appendix to ASTM A 53-88a			
NPS (NOMINAL PIPE SIZE)	OUTSIDE DIAMETER in (mm)	SCHEDULE NO.	WALL THICKNESS in (mm)
1/2	0.840 (21.3)	40 80	0.109 (2.77) 0.147 (3.73)
3/4	1.050 (26.7)	40 80	0.113 (2.87) 0.154 (3.91)
1	1.315 (33.4)	40 80	0.133 (3.38) 0.179 (4.55)
1-1/4	1.660 (42.2)	40 80	0.140 (3.56) 0.191 (4.85)
1-1/2	1.900 (48.3)	40 80	0.145 (3.68) 0.200 (5.08)
2	2.375 (60.3)	40 80	0.154 (3.91) 0.218 (5.54)
2-1/2	2.875 (73.0)	40 80	0.203 (5.16) 0.276 (7.01)
3	3.500 (88.9)	40 80	0.216 (5.49) 0.300 (7.62)
3-1/2	4.000 (101.6)	40 80	0.226 (5.74) 0.318 (8.08)
4	4.500 (114.3)	40 80	0.237 (6.02) 0.337 (8.56)
5	5.563 (141.3)	40 80	0.258 (6.55) 0.375 (9.52)
6	6.625 (168.3)	40 80	0.280 (7.11) 0.432 (10.97)
8	8.625 (219.1)	40 80	0.322 (8.18) 0.500 (12.70)
10	10.750 (273.0)	40 80	0.365 (9.27) 0.594 (15.09)
12	12.750 (323.8)	40 80	0.406 (10.31) 0.688 (17.48)
14	14.000 (355.6)	40 80	0.438 (11.13) 0.750 (19.05)
16	16.000 (406.4)	40 80	0.500 (12.70) 0.844 (21.44)
18	18.000 (457.2)	40 80	0.562 (14.27) 0.938 (23.83)
20	20.000 (508.0)	40 80	0.594 (15.09) 1.031 (26.19)
24	24.000 (609.6)	40 80	0.688 (17.48) 1.219 (30.96)

5.4 Volume of Gas to Be Used for Sizing Piping and Tubing Systems

Intent and Rationale — Clause 5.4

The requirements of Clause 5.4 are intended to define the acceptable means for determining the volume of gas to be used for the sizing of piping and tubing systems.

The rationale for the requirements of this Clause is conveyed within the requirements themselves, except for Clause 5.4.3.

5.4.3 When a diversity of load has been established to the satisfaction of the *authority having jurisdiction*, a percentage of the total volume may be used.

Intent and Rationale — Clause 5.4.3

The intent of Clause 5.4.3 is to permit a reduction in the maximum capacity of the piping or tubing system when the likelihood of the coincident operation of all of the appliances being served is very low.

In buildings with a large number and diversity of gas appliances, for example, a multi-unit apartment building, the likelihood of all of the appliances operating at the same time may be extremely low. If the maximum capacity of the piping or tubing system is determined as the total input of all installed appliances, the size of the main building supply, and possibly main building branches, may be excessively large and expensive. A reduction in the maximum capacity may be permitted provided a reasonable basis for the reduction can be established to the satisfaction of the authority having jurisdiction. Appropriate methods of establishing the reduced capacity may include data from similar installations (acceptable past performance) or proven methods developed by the gas utility or propane distributor.

5.5 Allowable Pressure and Pressure Drop

Intent and Rationale — Clause 5.5

The requirements of Clause 5.5 are intended to provide the basis for determining the allowable pressure and pressure drop used in the sizing of piping and tubing systems.

The rationale for the requirements of this Clause is conveyed within the requirements themselves

5.6 Extensions

Intent and Rationale — Clause 5.6

Clause 5.6 is intended to provide the basis for extending existing piping or tubing systems.

The rationale for the requirements of this Clause is conveyed within the requirements themselves

5.7 Location

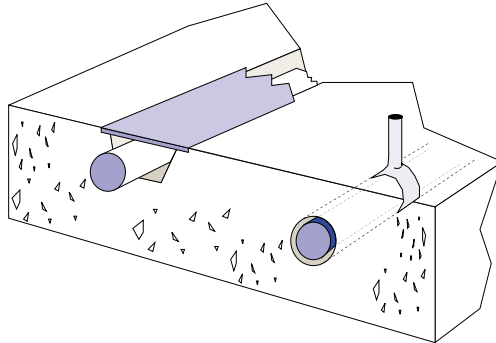
Intent and Rationale — Clause 5.7

The requirements of Clause 5.7 are intended to restrict the location of piping and tubing in order to permit inspection and testing, and to avoid reasonably foreseeable safety and performance problems.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.

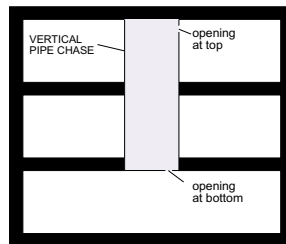
PIPING OR TUBING IN SOLID FLOORS

Piping or tubing in solid floors, such as concrete, shall be laid in channels and suitably covered to permit access to the piping or tubing.



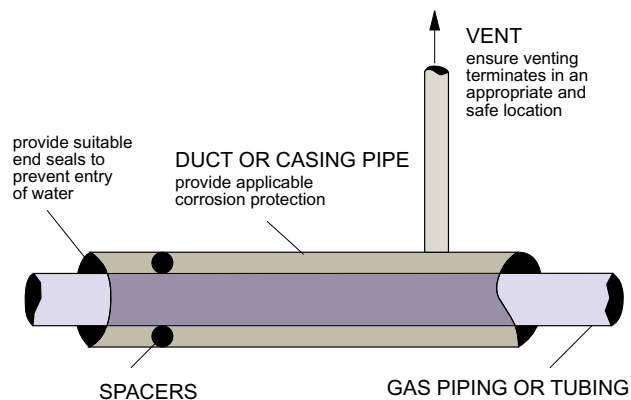
Alternatively, the piping or tubing shall be encased in ducts so that there is a free air space of not less than 0.5 in (13 mm) around the pipe or tube; the duct must be suitably ventilated.

PIPE CHASE VENTING



Each vertical pipe chase must have an opening at the top and at the bottom with a minimum opening area equal to a 1 in (25 mm) round opening.

ENCASED PIPING OR TUBING REQUIREMENTS



5.8 Piping Practices

Intent and Rationale — Clause 5.8

The intent of Clause 5.8 is to generally define acceptable piping practices in terms of assembly and installation.

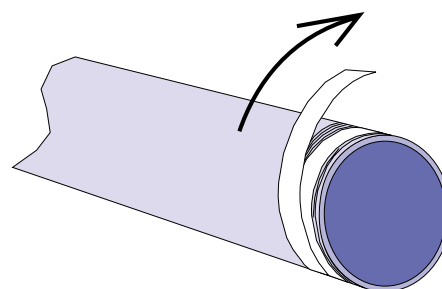
The rationale for the requirements of this Clause is conveyed within the requirements themselves.

Table 5.8.3
Spacing of Supports for Piping

NPS	Maximum spacing of supports ft (m)
1/2 or less — horizontal	6 (2)
3/4 – 1 — horizontal	8 (2.5)
1-1/4 – 2-1/2 — horizontal	10 (3)
3 – 4 — horizontal	15 (5)
5 – 8 — horizontal	20 (6)
10 or larger — horizontal	25 (8)
1-1/4 or larger — vertical	Every floor but not more than 125% of horizontal spacings
Tubing — all sizes — vertical and horizontal	6 (2)

JOINT SEALANT TAPE APPLICATION

Apply tape to male threads by stretching in clockwise direction with a 50% overlap leaving the first two starter threads bare.



5.9 Joints and Connections

Intent and Rationale — Clause 5.9

Clause 5.9 is intended to establish the acceptable means of joining and connecting piping and tubing.

The requirements of this Clause are based on acceptable and proven practice, and their rationale is conveyed within the requirements themselves

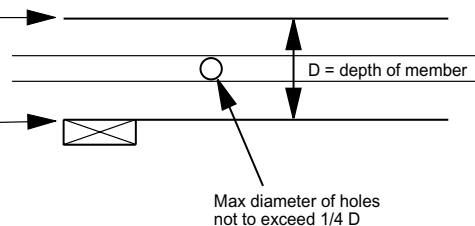
DRILLING AND NOTCHING IN WOOD FRAMING

Article 9.23.5 of the *National Building Code of Canada* specifies the permissible notching and drilling of wood framing members.

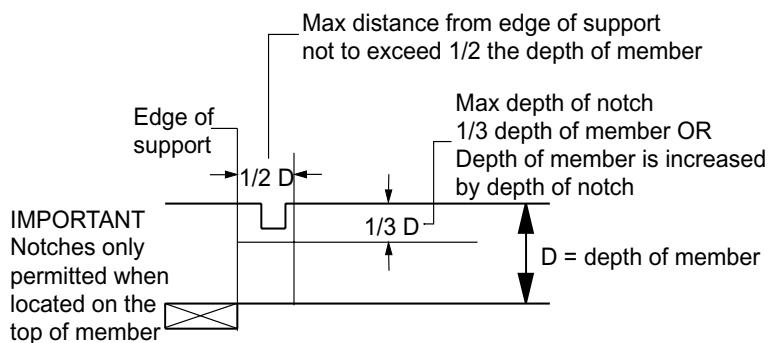
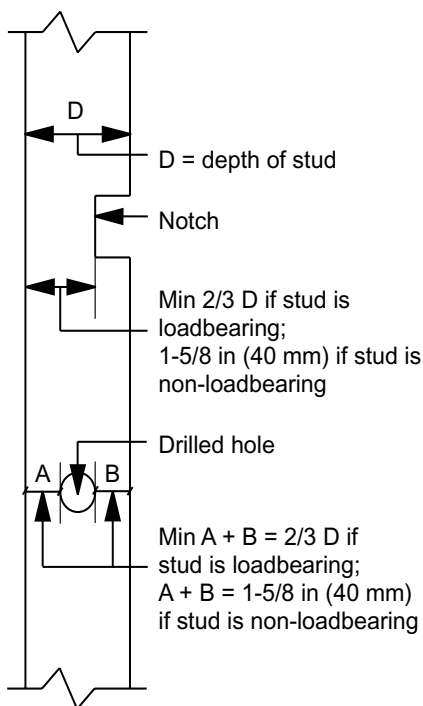
The figures and tables on this page summarize these requirements.

For materials such as concrete and steel, obtain advice from a structural engineer prior to notching or drilling any structural members.

Holes must be located a min of 2 in (50 mm) from edge of member
OR
depth of member must be increased by size of hole



Horizontal Member Size	Maximum Hole Diameter
2 x 4 in (38 x 89 mm)	not permitted
2 x 6 in (38 x 140 mm)	1-3/8 in (35 mm)
2 x 8 in (38 x 184 mm)	1-3/4 in (46 mm)
2 x 10 in (38 x 235 mm)	2-1/4 in (58 mm)
2 x 12 in (38 x 286 mm)	2-3/4 in (71 mm)



Maximum Size of Notch or Drilled Hole		
Stud	Load bearing	Non-loadbearing
2 x 4 in (38 x 89 mm)	1-1/8 in (30 mm)	1-7/8 in (48 mm)
2 x 6 in (38 x 140 mm)	1-3/4 in (46 mm)	3-7/8 in (98 mm)

Member Size	Maximum Distance from Edge of Support	Maximum Depth of Notch
2 x 4 in (38 x 89 mm)	1-3/4 in (44 mm)	1-1/8 in (30 mm)
2 x 6 in (38 x 140 mm)	2-3/4 in (70 mm)	1-3/4 in (46 mm)
2 x 8 in (38 x 184 mm)	3-5/8 in (92 mm)	2-3/8 in (61 mm)
2 x 10 in (38 x 235 mm)	4-5/8 in (117 mm)	3 in (78 mm)
2 x 12 in (38 x 286 mm)	5-5/8 in (143 mm)	3-3/4 in (95 mm)

5.10 Branch Piping Outlets

Intent and Rationale — Clause 5.10

The intent of Clause 5.10 is to provide the fullest flexibility for future extensions to a piping system.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.

5.11 Appliance Connections

Intent and Rationale — Clause 5.11

Clause 5.11 is intended to provide general requirements for appliance connections.

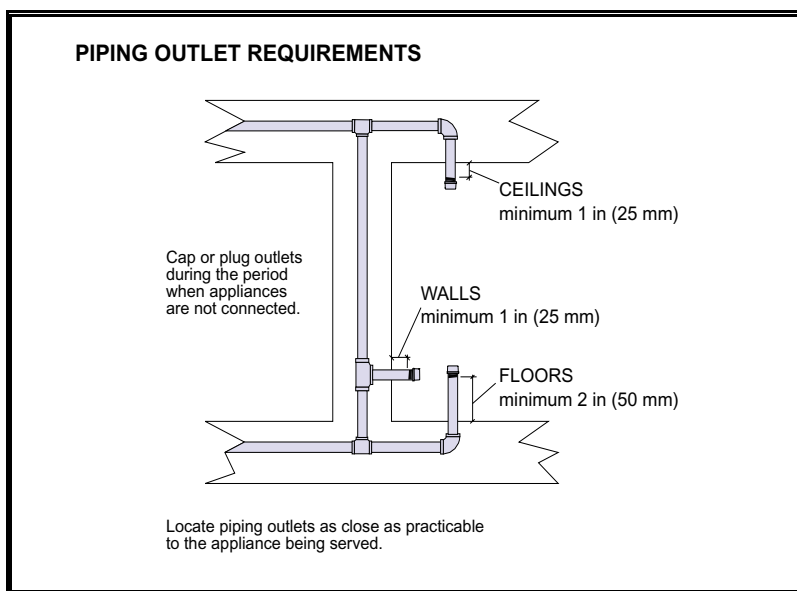
The rationale for the requirements of this Clause is conveyed within the requirements themselves.

5.12 Piping Outlets

Intent and Rationale — Clause 5.12

Clause 5.12 is intended to provide requirements for the capping or plugging of unconnected piping outlets, the minimum length of piping outlet extensions beyond finished ceilings, walls, and floors, and their location in relation to the appliances they serve.

The requirements for the extension of piping outlets beyond finished surfaces are based on the minimum clearance required to work on the outlet using two wrenches. The rationale for the remaining requirements of this Clause is conveyed within the requirements themselves.



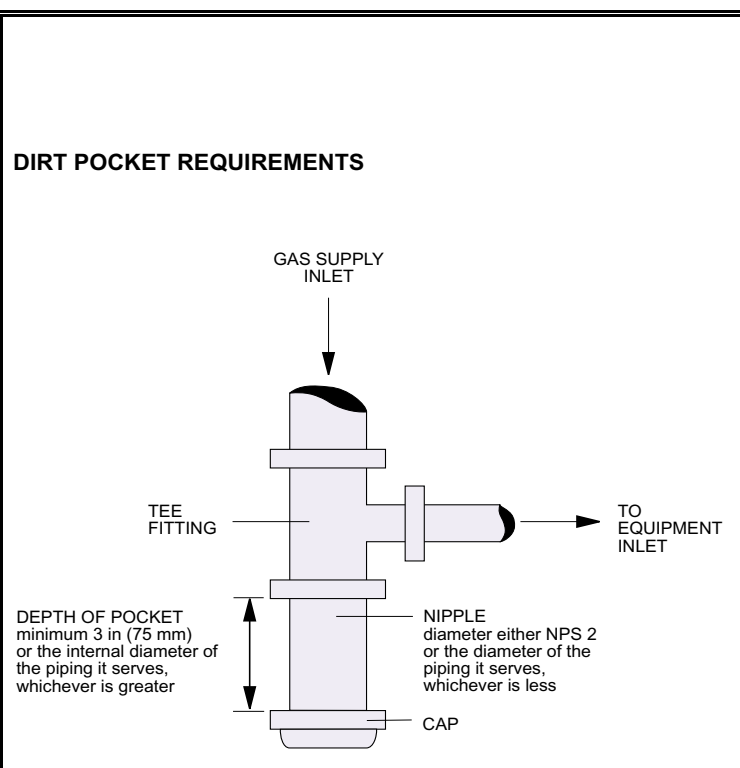
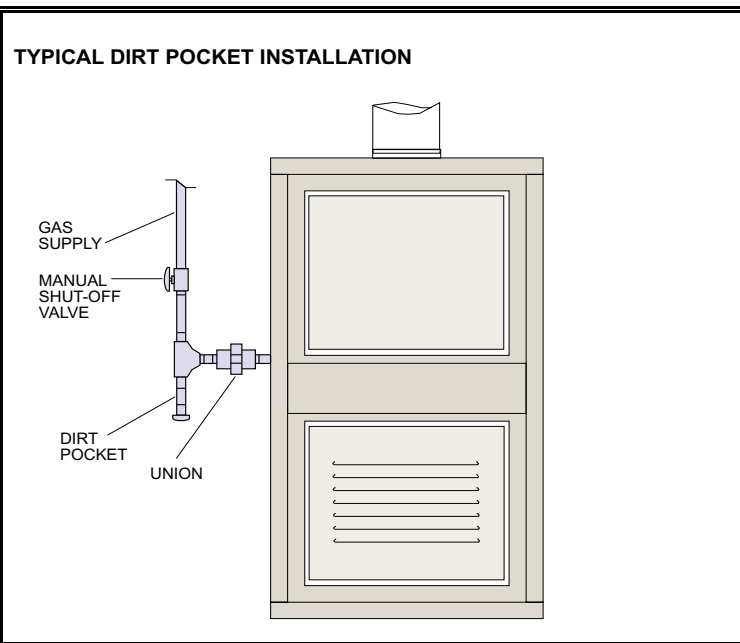
5.13 Drip and Dirt Pockets

Intent and Rationale — Clause 5.13

The requirements of Clause 5.13 are intended to establish where drip and dirt pockets are , required and how they are to be sized, arranged,

and connected.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.



5.14 Prohibited Practices

Intent and Rationale — Clause 5.14

This Clause is intended to identify prohibited piping practices that could lead to a reduced level of safety and performance.

The rationale for Clause 5.14 is based on past experience. It is considered self-explanatory for the most part; however, the rationale for specific requirements is provided as follows:

The nesting of bushings is prohibited since the relatively thin walls of bushings can easily lead to fractures when a nest of bushings is tightened. The likelihood of leakage when a number of bushings are nested is also significantly higher; a proper reduction fitting should always be used in such cases.

Fittings containing both left and right hand threads are susceptible to the loosening of one end when the other is being tightened. Thread protectors and running threads do not allow for proper seating and thread lock-up, thereby leading to a higher likelihood of leakage.

Swing joints are susceptible to loosening at the joints over time, and cannot be installed in concealed locations for this reason.

The field bending of pipe is prohibited since this may induce stresses that can lead to rupture and leakage.

Piping or tubing cannot be used as a ground because it does not comply with the applicable requirements of the *Canadian Electrical Code* and may potentially result in an electrical hazard. Bonding of piping or tubing is permitted; however, the bond must be connected to an approved electrical ground.

Close nipples do not have a shoulder, resulting in a lack of seating that can lead to leakage. Street elbows and tees are not permitted because these fittings have both male and female threaded ends. This makes

alignment of the piping difficult since the direction of the piping does not always correspond with the fully seated position of the fitting. When the connection is backed off to align the piping, leakage may result.

Any poor practice, including those not specifically stated in this Clause, is also prohibited.

5.15 Underground Piping and Tubing

Intent and Rationale — Clause 5.15

The requirements of Clause 5.15 are intended to identify the acceptable means of installing underground piping and tubing.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.

DEPTH OF PIPE BURIAL REQUIREMENTS

Backfill material must be free of sharp objects, large stones, or any other material that may damage the piping or tubing.

Piping must rise above grade prior to entering the building.

minimum
24 in (600 mm)
under a commercial
driveway

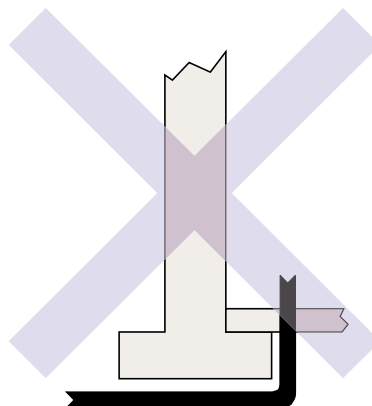
minimum
15 in
(400 mm)

Additional depth may be required in areas where physical damage may occur, such as farm operations.
Properly grade trench to avoid pipe sagging.

Note: Plastic piping or tubing must be accompanied by a tracer wire or equivalent media.

PROHIBITED PRACTICE

Piping must not pass under a footing or building wall since settlement of the building may result in crushing or rupture of the pipe.



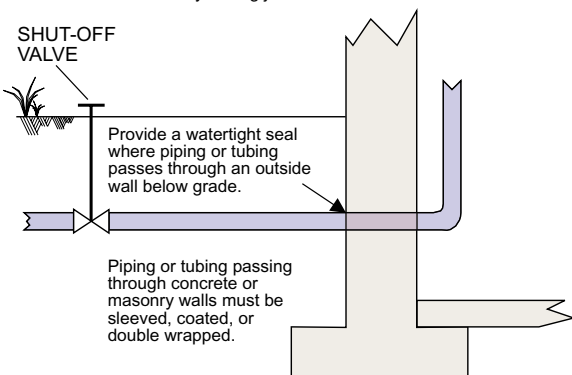
BELOW GRADE ENTRY REQUIREMENTS

Piping entering a building shall rise above grade before entry, except with permission of the authority having jurisdiction.

SHUT-OFF
VALVE

Provide a watertight seal where piping or tubing passes through an outside wall below grade.

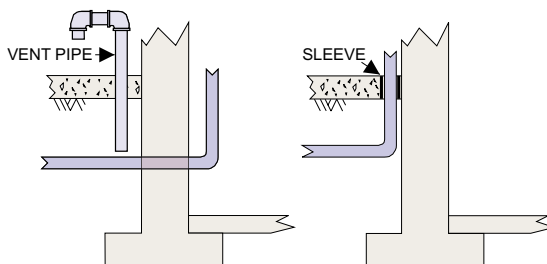
Piping or tubing passing through concrete or masonry walls must be sleeved, coated, or double wrapped.



PIPE VENTING REQUIREMENTS

When piping or tubing is entirely covered with paving, or paving extends 25 ft (8 m) or more from the building, a vent pipe inspection point must be installed.

Provide a sleeve in the pavement to permit the free movement of piping or tubing. Note: a sleeve may also serve as a vent pipe inspection point.



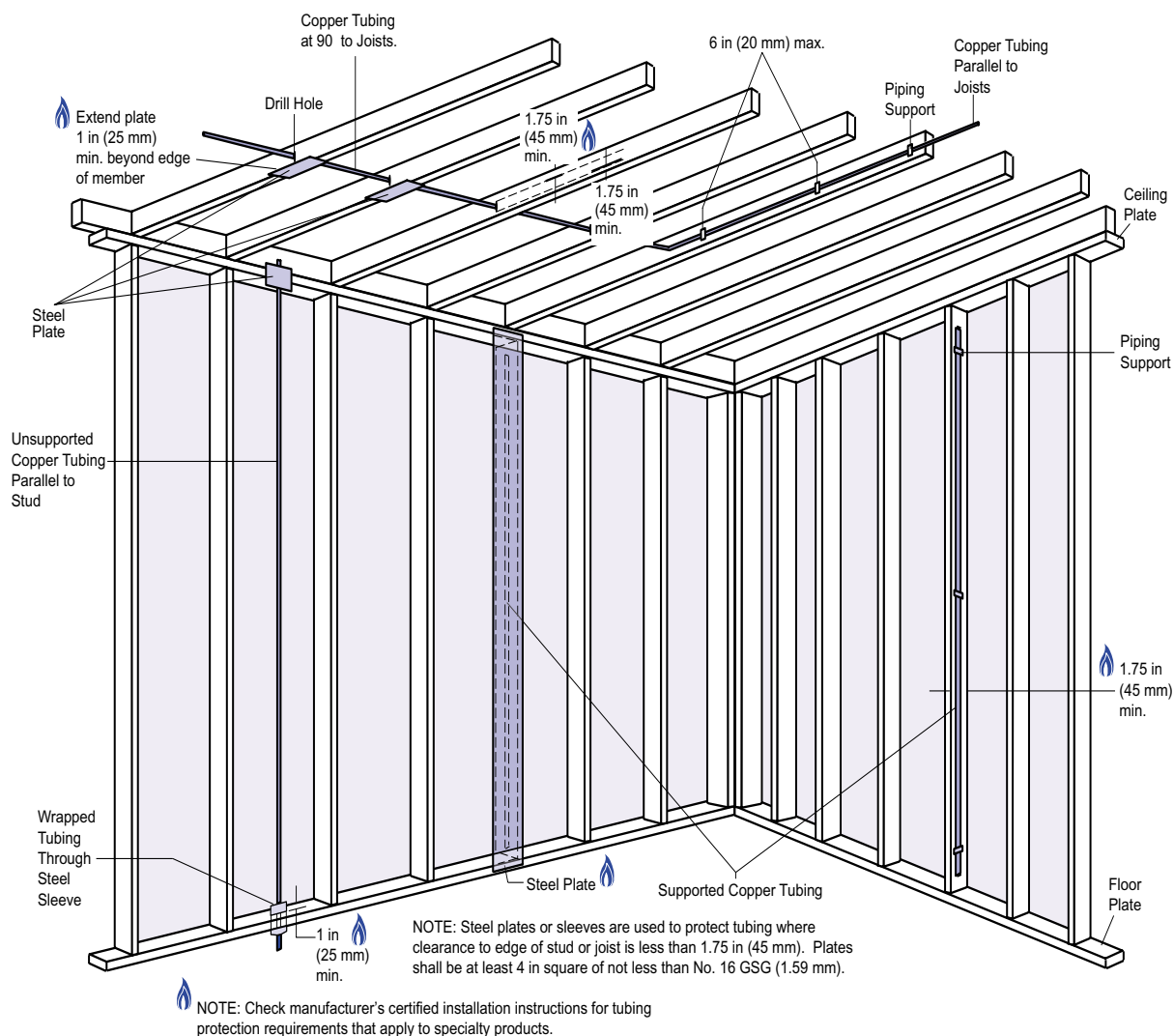
5.16 Protection of Piping and Tubing

Intent and Rationale — Clause 5.16

Clause 5.16 is intended to establish the means by which piping and tubing are to be protected from mechanical and environmental damage.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.

TUBING PROTECTION REQUIREMENTS



5.17 Identification of Piping or Tubing

Intent and Rationale — Clause 5.17

The intent of Clause 5.17 is to establish the means by which piping and tubing must be identified in order to enable servicing and prevent accidents resulting from misidentification.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.

5.18 Manual Shut-Off Valves

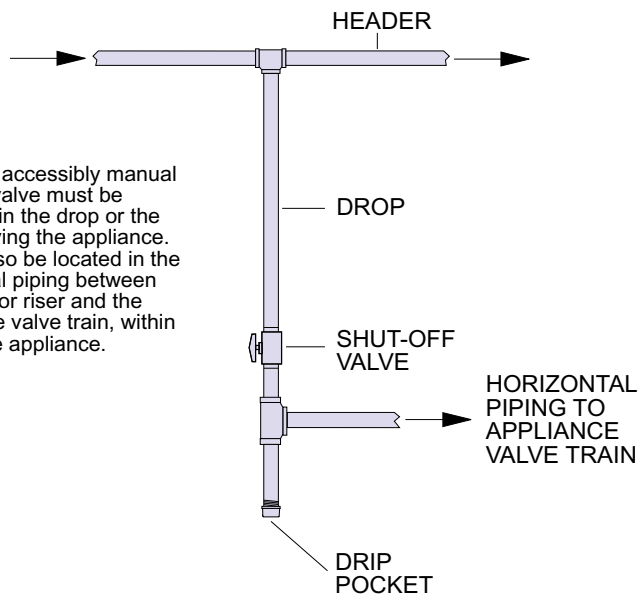
Intent and Rationale — Clause 5.18

The requirements of Clause 5.18 are intended to identify the type, location, and identification markings of manual shut-off valves to enable servicing. They are also intended to provide facilities having multiple gas outlets with a clearly identified shut-off valve in a readily accessible location within the space where the outlets are located, so that, in the event of an accident or emergency, all outlets may easily be shut off. They are also intended to specify that the plugging or capping of the gas supply is required when the facility is taken out of service to avoid possible accidents.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.

MANUAL SHUT-OFF VALVES

A readily accessible manual shut-off valve must be installed in the drop or the riser serving the appliance. It may also be located in the horizontal piping between the drop or riser and the appliance valve train, within 2 ft of the appliance.



5.19 Manual Reset Valves

Intent and Rationale — Clause 5.19

Clause 5.19 is intended to specify that safety control devices that are external to a piping system require an automatic valve of the manual reset type, so that activation of the safety control device will automatically shut off the supply of gas.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.

5.20 Hose and Hose Fittings

Intent and Rationale — Clause 5.20

The requirements of Clause 5.20 are intended to prohibit the unsafe use of hose connections and provide criteria for the safe and acceptable use of hose, hose connections, and fittings.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.

5.21 Connectors

Intent and Rationale — Clause 5.21

Clause 5.21 is intended to provide requirements for connectors in accordance with the applicable compliance standards for connectors, their permitted use, location, and installation.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.

5.22 Testing of Piping, Tubing, Hose, and Fittings

Intent and Rationale — Clause 5.22

The requirements of Clause 5.22 are intended to reasonably assure the gas tightness of piping, tubing, and hose systems by means of the applicable pressure test methods and criteria.

The rationale for these requirements is conveyed within the requirements themselves.

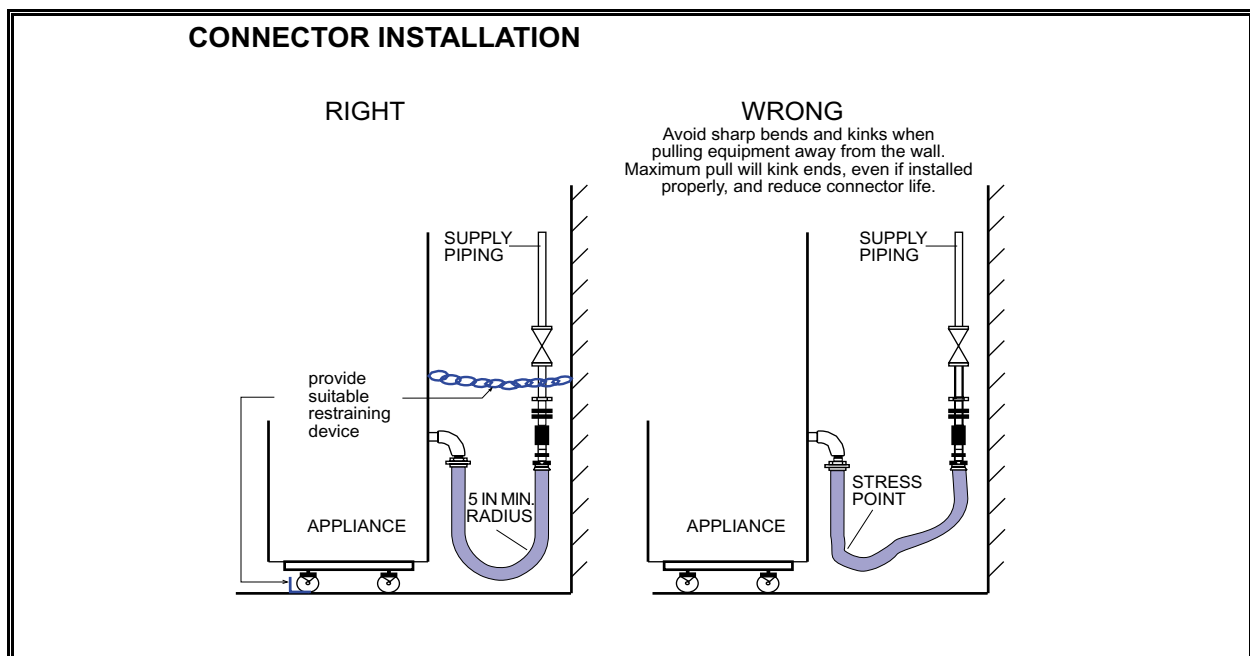


Table 5.22.2
Pressure Test Requirements

Working pressure psig (kPa)	Diameter of pipe or tubing	Length of pipe or tubing ft (m)	Test pressure psig (kPa)	Test duration min
Up to and including 2 (14)	All sizes	200 (60) or less	15 (100)	15
Up to and including 2 (14)	All sizes	More than 200 (60)	15 (100)	60
Over 2 (14) but not more than 33 (230)	All sizes	200 (60) or less	50 (340)	60
Over 2 (14) but not more than 33 (230)	All sizes	More than 200 (60)	50 (340)	180
Over 33 (230)	All sizes	All lengths	1.5 times the maximum operating pressure	180
All welded pipe	All sizes	All lengths	50 psig or 1.5 times the maximum operating pressure	180

Notes :

(1) *These test pressures and time durations are minimum requirements. Circumstances may require test pressures and time durations in excess of those shown in the Table.*

(2) *All wrapped and/or factory-coated piping systems, of all sizes and lengths, shall be tested at a minimum pressure of 100 psig in accordance with the time duration in the Table.*

Intent and Rationale — Note (2)

The requirements of Note (2) are not intended to apply to certified piping systems such as corrugated stainless steel tubing, since these have been factory-tested and already comply with this requirement.

5.23 Purging of Piping and Tubing Systems and Hose After Leak Testing

Intent and Rationale — Clause 5.23

Clause 5.23 is intended to provide a safe means of purging piping and tubing systems and hose after leak testing.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.

5.24 Purging Gas from a Piping or Tubing System

Intent and Rationale — Clause 5.24

The requirements of Clause 5.24 apply to the purging of piping or tubing systems containing natural gas or propane and are intended to provide requirements in addition to the applicable procedures in Clause 5.23.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.

5.25 Generators

Intent and Rationale — Clause 5.25

The requirements of Clause 5.25 are intended to minimize the potential for the interruption of the supply of gas to emergency generators providing power for safety purposes.

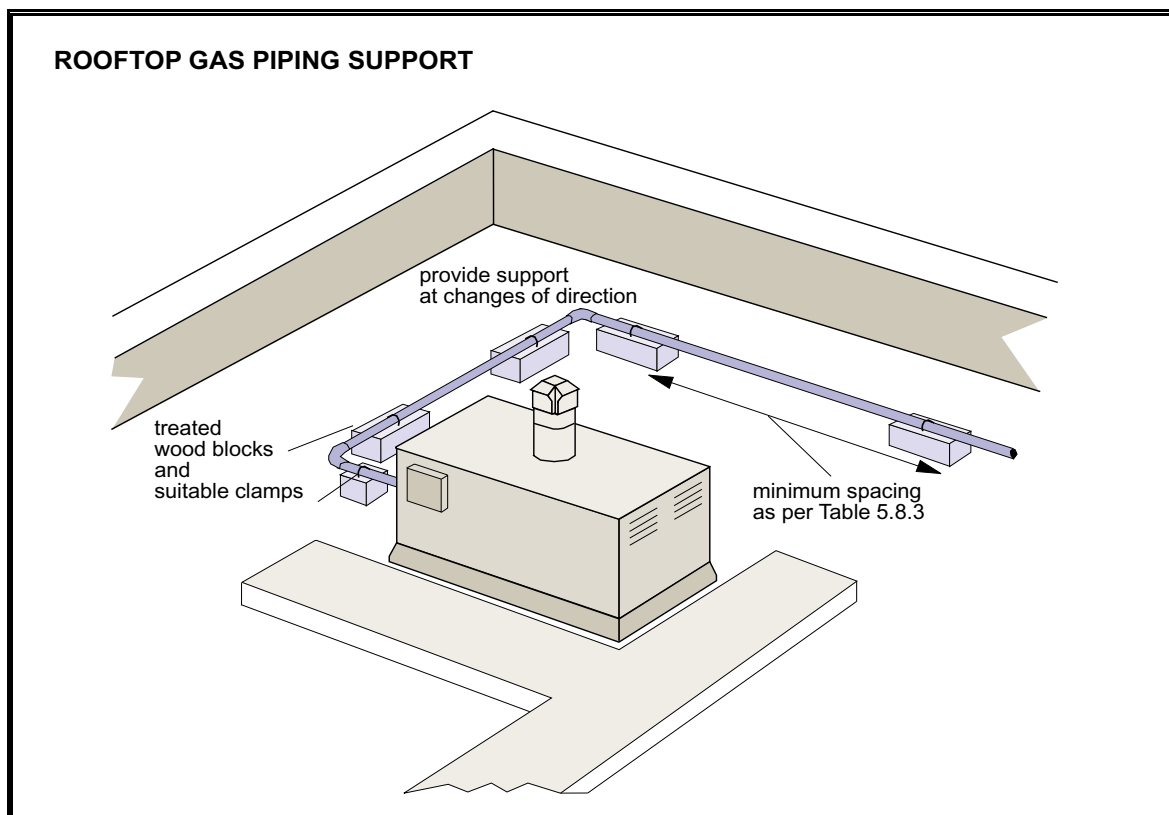
The rationale for the requirements of this Clause is conveyed within the requirements themselves.

5.26 Rooftop Gas Piping and Tubing

Intent and Rationale — Clause 5.26

The requirements of Clause 5.26 are intended to ensure the suitable support of piping and tubing serving rooftop gas appliances, including protection against exposure, vibration, and thermal expansion.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.



5.27 Inspection

5.27.1 Plastic piping and tubing shall be inspected before and after installation for defects such as cuts, scratches, and gouges. Damaged cylindrical pieces shall be cut out and replaced. Inspection shall be adequate to confirm that sound joints have been made.

5.27.2 Joints in plastic piping and tubing shall be visually checked for evidence of poor bonding. Where inspection reveals defective joints, they shall be cut out and replaced.

Intent and Rationale — Clause 5.27

This Clause is intended to confirm that plastic piping and tubing are not damaged, and when damaged, that they are suitably repaired.

The rationale for the requirements of this Clause is conveyed within the requirements themselves

NOTE ON PIPING AND TUBING SIZING EXAMPLES

The section of the handbook that follows provides a series of explanations and examples for the installation and sizing of piping and tubing systems.

They are intended to assist Code users in the proper application of typical sizing and installation procedures. Always keep in mind that the requirements of the local authority having jurisdiction may differ and may take precedence.

Examples for the sizing of both natural gas and propane systems have been developed in this section. While the same principles apply, do not confuse the sizing tables for natural gas with those for propane.

The tables from Appendix A (Natural Gas) and Appendix B (Propane) of the B149.1 Code have not been reproduced here; refer to your copy of

the Code when working through the examples provided in the section that follows.

While every effort has been made to provide accurate examples, it remains the responsibility of the Code user to ensure that procedures are correctly applied in practice.

SIZING OF PIPING AND TUBING

FACTORS AFFECTING PIPE SIZING

Gas piping should be large enough and installed in such a way as to provide enough gas to meet maximum demand without undue loss of pressure between the meter and the appliances. The size of gas piping will depend on the following factors:

Fuel Type

The sizing of piping and tubing is different for natural gas and propane, due to the differences in specific gravity and delivery pressure. Propane examples start on page 99.

Length of Run

The longer the piping or tubing, the greater the pressure drop of the system.

Internal Pipe Roughness and Number of Fittings

Internal pipe roughness, bends, fittings, and valves restrict gas flow and reduce pressure through the system. In most residential applications, the bends, fittings, and valves will not significantly contribute to pressure drop, but in larger applications, fittings, valves, and bends are factors.

Note: *The pipe sizing tables in Appendix A (Natural Gas) and Appendix B (Propane) of the B149.1 Code already allow for a sufficient number of fittings for most typical installations.*

Allowable Pressure Drop

Natural Gas — For older, low pressure systems with supply pressures less than 7 in w.c. (1.75 kPa), the allowable pressure drop is 0.5 in w.c. (125 Pa). In residential and commercial systems with a supply pressure of 7 to 14 in w.c. (1.75 to 3.5 kPa), the allowable pressure drop is 1 in w.c. (250 Pa). In systems of delivery pressure greater than or equal to 2 psig (14 kPa), the allowable pressure drop is 75% of supply pressure.

Propane — In residential and commercial systems with a supply pressure up to and including 14 in w.c. (3.5 kPa), the allowable pressure drop is 1 in w.c. (250 Pa). For systems operating at 2 psig, the allowable pressure drop is determined from Tables B.2 and B.2(Metric). In systems of delivery pressure greater than 2 psig (14 kPa), the allowable pressure drop must not impair an adequate supply of propane to each appliance.

Maximum Gas Consumption

The more gas an appliance requires, the larger the pipe must be to deliver that gas to the appliance without undue pressure drop.

Configuration of the Piping System

The configuration of the piping system affects the procedure for pipe sizing, depending on whether branch runs or individual runs are used.

PROCEDURE FOR SIZING PIPE

The following procedure for sizing pipe applies in principle to pipe carrying natural gas and propane.

1. Determine the design system pressure, the allowable pressure drop for that pressure, and whether steel pipe or copper tube will be used.
2. Determine the maximum gas demand for each appliance to be served. The demand should be in units of Btuh or kW.
3. For branch run pipe configurations, measure the longest piping run. This is usually from the meter set to the most remote appliance or from the system regulator to the most remote appliance. This is the length to be used in sizing all branch piping runs (see Steps 4 to 8).
4. For individual pipe runs, measure each run from the meter set to the appliance and use this length to size each run (see Step 8).
5. In the Piping Size Table of Appendix A (Natural Gas) or Appendix B (Propane), whichever is appropriate, for the system pressure and pressure drop, find the row showing the measured length of longest piping run or the next longer length if the exact figure is not given. This row will be used to size all the branch piping runs.
6. Starting at the most remote appliance, find the demand for that appliance in the horizontal row just selected. If the exact demand is not given, read horizontally to the right and use the next (higher) figure.
7. Read vertically up the table to the pipe size given in the top row, above the appliance's demand. This is the size of pipe required to deliver the maximum volume of natural gas at the pressure specified, with the allowed pressure drop.
8. Proceed in a similar manner for each appliance and each section of piping. For each section of piping, determine the total gas demand to all appliances downstream of that section.
9. For individual runs, use the length of run to each appliance measured from the meter set, or system regulator, and the appliance input to size piping or tubing using the appropriate table from Appendix A (Natural Gas) or Appendix B (Propane).

Note: Engineered design or other methods acceptable to the authority having jurisdiction may also be used to size piping systems.

PIPE SIZING TABLES

Tables have been compiled in the Codes for sizing the most frequently found piping systems. The formula used to derive the tables contains a factor that allows for a reasonable number of fittings equivalent to 20% of the actual pipe length. Therefore, separate lengths equivalent to resistance due to fittings need not be calculated if these tables are used. However, if the piping system has an unusually large number of fittings, each fitting should be accounted for, and tables

without fittings, or the formulas given in Appendix A, should be used. Descriptions of how to use the tables are also included in the Code. Refer to these tables when following through the examples. A summary of the available tables for natural gas listed in Appendix A has been provided below.

PIPING MATERIALS

Gas piping may be steel, copper, or polyethylene.

Steel Piping

Steel piping is generally schedule 40, which is rated for pressures lower than 862 kPa (125 psig). Approved weld type or threaded malleable iron or steel fittings must be used on steel pipe.

Copper Tubing

Copper tube is usually inside buildings, with gas pressure of 2 psig (14 kPa). Copper tube is much

more convenient to use than steel pipe because it can be bent and the fittings are easier to install. The copper tubing used in gas service must be an approved type. Likewise, all fittings used in a copper system must be approved for use with copper tubing in gas service.

Polyethylene

Polyethylene (PE) pipe is only used in underground service. It generally connects to the steel aboveground house piping via a special steel-to-polyethylene transition fitting. PE pipe containing gas must have a tracer wire attached (see Clause 5.15.14) so that it can be easily located. The tracer wire is a thin (14 gauge) wire taped along the length of the PE pipe.

Extreme caution must be exercised when digging or excavating in locations where gas pipe may be laid; make every effort to locate gas pipe before digging.

Any defective section of piping must be replaced, not repaired.

**SUMMARY OF PIPING AND TUBING SIZING TABLES FOR NATURAL GAS
IN APPENDIX A OF B149.1 CODE**

Units	Absolute Pressure	Allowable Pressure Drop	Pipe or Tube Type	Appendix A Table* Pipe or Copper Tube
Imp	<7 in w.c. 0.25 psig	0.5 in w.c.	Schedule 40 pipe or copper	A.1 or A.8
SI	<1.75 kPa	125 Pa	Schedule 40 pipe or copper	A.1(M) or A.8(M)
Imp	7 in to 14 in w.c.	1 in w.c.	Schedule 40 pipe or copper	A.2 or A.9
SI	1.75 to 3.5 kPa	250 Pa	Schedule 40 pipe or copper	A.2(M) or A.9(M)
Imp	2 psig	1 psig	Schedule 40 pipe or copper	A.3 or A.10
SI	14 kPa	7 kPa	Schedule 40 pipe or copper	A.3(M) or A.10(M)
Imp	2 psig	1.5 psig	Schedule 40 pipe or copper	A.4 or A.11
SI	14 kPa	10 kPa	Schedule 40 pipe or copper	A.4(M) or A.11(M)
Imp	5 psig	2.5 psig	Schedule 40 pipe or copper	A.5 or A.12
SI	34 kPa	17 kPa	Schedule 40 pipe or copper	A.5(M) or A.12(M)
Imp	10 psig	5 psig	Schedule 40 pipe or copper	A.6 or A.13
SI	70 kPa	35 kPa	Schedule 40 pipe or copper	A.6(M) or A.13(M)
Imp	20 psig	10 psig	Schedule 40 pipe or copper	A.7 or A.14
SI	140 kPa	70 kPa	Schedule 40 pipe or copper	A.7(M) or A.14(M)

* NOTE: Metric (SI) tables are denoted with (M) following the table number.

Joints, Connectors, and Fittings

Fittings must connect pipe without allowing any gas leakage, without placing additional stress on the pipe, and with consideration given for long life. All fittings must be approved for use in the service and on the materials of the installation. Specific installation requirements for fittings, connectors, and joints are described in the current Code. Fittings on steel pipe are generally threaded; connections on copper tube are generally flared brass fittings; and PE fittings are generally fused.

LOCATION OF PIPING

Piping may be run behind walls, in ceilings or floors, or in plain sight. Consideration must be given to the safety of the location, in terms of possible corrosion, failure due to mechanical stresses, or gas diffusion in the case of a leak. It is generally good practice to run gas piping close to other services, such as electricity, water, and ducting. All pipe or tube carrying gas must be marked with yellow markers at specified intervals (see Clause 5.17). All piping must be tested and inspected before it may be concealed. Allowable and restricted gas piping locations are described in detail in the Code.

SUPPORT AND PROTECTION OF PIPING

Piping shall be held in place with appropriate pipe supports as described in the Code. The supports should not decrease the strength of any structural member of the building, such as a notch cut in a beam. Copper tube must be protected from nail puncture with smash plates. Gas piping on rooftops must allow for expansion and contraction due to ambient temperature. Piping may be painted; it must be adequately protected from any likely corrosion.

PRESSURE TESTING

Testing of the house piping system includes three steps:

1. Pressure testing the piping only at higher pressures than normal operating pressure (without appliances connected).

2. Pressure testing at working pressure of entire system, with all appliances, components, and meters connected. This test involves looking for a drop in pressure (using a gauge) over an approved period of time.
3. Testing all valves, connections, etc, for leaks by liquid solution or some other appropriate leak detection system.

This procedure and the required tests are described in detail in the B149.1 Code (see Clause 5.22).

UNDERGROUND PIPING

The most important considerations for underground gas piping are compatibility with soil, long life of fittings and joints, support that will not shift, and entry of the pipe into the building. Piping generally lies 24 in (0.6 m) below grade; it may be located under driveways, sidewalks, or other paved surfaces. Underground piping is generally installed by the builder only in applications where one meter set serves several remote locations on the premises, such as industrial complexes and condominiums. Currently, polyethylene pipe is installed for most service connections. All steel underground piping must be cathodically protected. Refer to Clause 5.15 for specific underground piping requirements.

EXAMPLE 1 — NATURAL GAS SCHEDULE 40 PIPE SIZING USING BRANCH RUNS

Determine the required minimum size of Schedule 40 iron pipe for each section and each outlet of the piping system shown in the figure below. The gas has a relative density of 0.60 and a heating value of 1000 Btu/ft³. The gas pressure in section A is 2 psig. The gas pressure from the system regulator to all appliances is less than 14 in w.c.

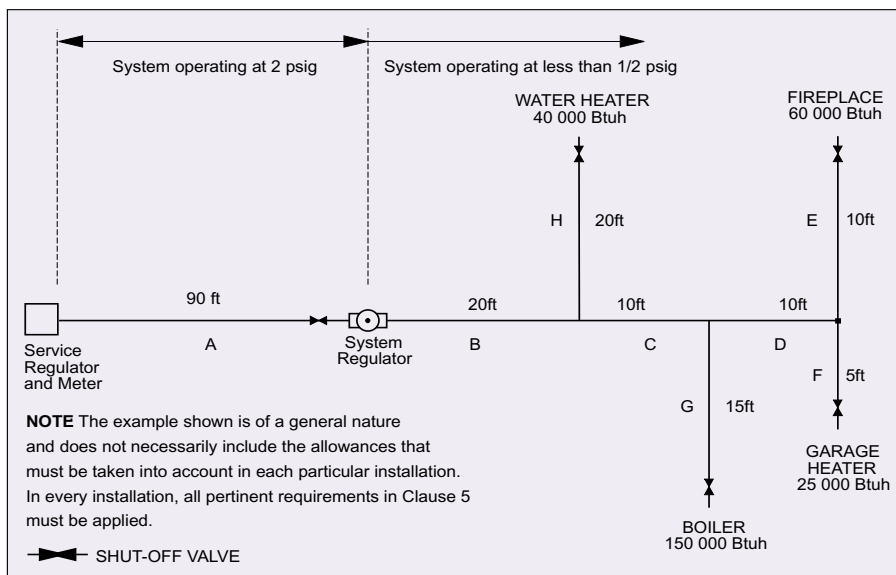
Find the pipe size for the sections from the system regulator to all appliance outlets:

The distance between the system regulator and the farthest appliance (fireplace) must be established

to determine the longest run of the system operating under the pressure of 14 in. This distance (50 ft) is then used to size the entire system downstream of the system regulator. The choice of tables for a specific application shall be determined by the pressure supplied to the system and the pressure drop allowed. For this example, Table A.2 applies. The results are tabulated below for piping sections B through H.

Find the pipe size for section A and a length of 90 ft:

For a gas pressure of 2 psig, Table A.3 applies. The pipe is sized using the length of 90 ft and a total input of 275 000 Btuh (see table below).



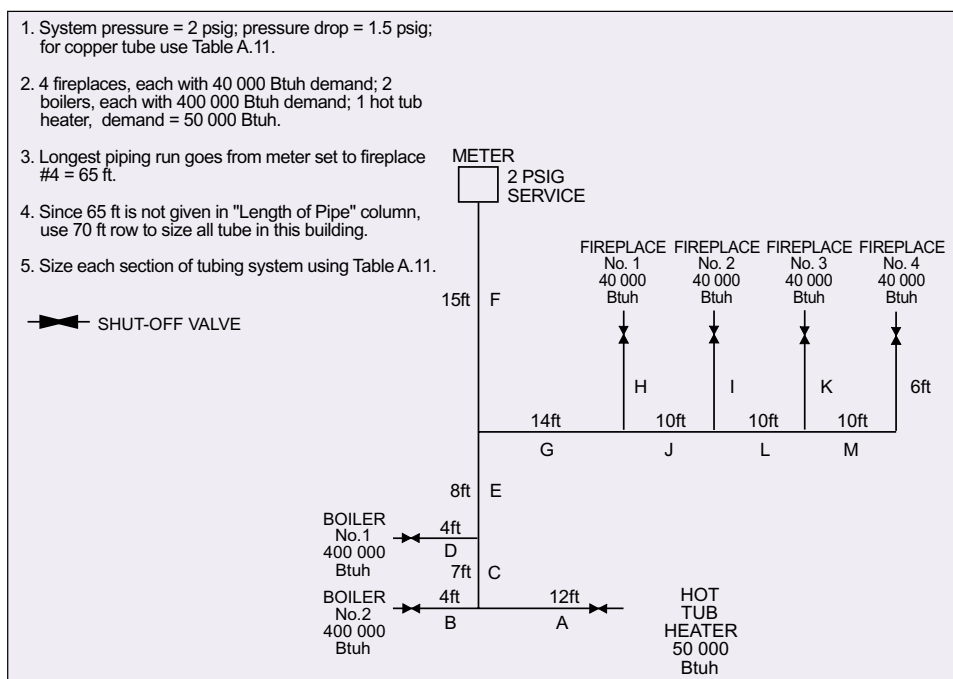
Section	Description	Sizing	
E	branch to fireplace	total demand = 60 000 Btuh; use NPS 1/2	All branches sized using Table A.2 and 50 ft length of pipe
F	branch to garage heater	total demand = 25 000 Btuh; use NPS 1/2	
G	branch to boiler	total demand = 150 000 Btuh; use NPS 3/4	
H	branch to water heater	total demand = 40 000 Btuh; use NPS 1/2	
D	branch to E and F	total demand = 85 000 Btuh; use NPS 1/2	
C	branch to D and G	total demand = 235 000 Btuh; use NPS 1	
B	branch to C and H	total demand = 275 000 Btuh; use NPS 1	use NPS 1/2
A	meter to system regulator	total demand = 275 000 Btuh; from Table A.3	

EXAMPLE 2 — NATURAL GAS RIGID COPPER TUBE SIZING USING BRANCH RUNS

This example illustrates the sizing of a rigid copper tubing system operating at 2 psig. The use of rigid copper tubing (referred to as copper piping in plumbing) is permitted provided it is of the appropriate grade and properly connected.

The procedure is described in the figure immediately below, and the results are summarized in the table at the bottom of this page.

The same sizing tables apply to both rigid and flexible copper tubing. Examples 3 to 6 illustrate the sizing of flexible copper tubing.



Section	Description	Sizing	
M	branch to fireplace #4	total demand = 40 000 Btuh; use 3/8 in	All branches sized using Table A.11 and 70 ft length of pipe
L	supply line to fireplace #3	total demand = 80 000 Btuh; use 3/8 in	
K	branch to fireplace #3	total demand = 40 000 Btuh; use 3/8 in	
J	supply line to fireplace #2	total demand = 120 000 Btuh; use 1/2 in	
I	branch to fireplace #2	total demand = 40 000 Btuh; use 3/8 in	
H	branch to fireplace #1	total demand = 40 000 Btuh; use 3/8 in	
G	supply line to fireplace #1	total demand = 160 000 Btuh; use 1/2 in	
F	15 ft house line	total demand = 1 010 000 Btuh; use 1-1/8 in	
E	8 ft supply line to boiler #1	total demand = 850 000 Btuh; use 7/8 in	
D	branch line to boiler #1	total demand = 400 000 Btuh; use 5/8 in	
C	7 ft supply line to boiler #2	total demand = 450 000 Btuh; use 3/4 in	
B	branch line to boiler #2	total demand = 400 000 Btuh; use 5/8 in	
A	branch line to hot tub	total demand = 50 000 Btuh; use 3/8 in	

FLEXIBLE COPPER TUBING SYSTEMS

Introduction and Background

In the mid-1960s, a number of American gas utilities underwent an extensive expansion program into areas previously not served by natural gas. A great number of the newly acquired conversion customers had existing finished homes piped for propane or other liquefied petroleum gas (LPG) service. The piping was generally copper tubing and was sized for conventional LPG pressure service (11 in w.c., 2.75 kPa). Therefore, the existing tubing was undersized for conversion to conventional natural gas service (7 in w.c., 1.75 kPa).

Since these were existing and, in most cases, older homes, with partially or completely finished interiors, it would have been costly and, in most cases, impractical to remove existing tubing systems and replace them with conventional inches water column (in w.c.) iron pipe systems. Since the existing tubing systems had performed well under LPG service and were capable of higher pressure service, the obvious solution was for a higher operating pressure capable of supplying the volumes required for natural gas service. Hence, the introduction of the 2 psig (14 kPa) interior tubing concept.

Although the existing 2 psig (14 kPa) system was originally conceived to capture former LPG customers, it was quickly recognized that the system had other advantages and, as a result, could be promoted for new construction as well. In particular, the 2 psig (14 kPa) system is viewed as a potentially attractive alternative for the apartment and townhouse (multi-unit) market. This market had been previously considered uneconomical and impractical to serve by the conventional in w.c. iron pipe system; the use of the 2 psig copper tubing systems improved the economics considerably.

The higher utilization pressure of 2 psig (14 kPa) and the higher allowable pressure drops of 1 psig (7 kPa), or 1.5 psig (10.5 kPa) where approved, combined with the use of small diameter copper

tubing should also provide considerable added flexibility to the installer and customer. This should result in easier, less expensive installations and expanded natural gas use in other, currently less popular, applications.

2 psig Delivery Systems

Historically, natural gas was delivered to buildings at medium pressure (approximately 60 psig/410 kPa and regulated down to low pressure (approximately 7 in w.c./1.75 kPa) at the meter set.

Current technology, however, has allowed widespread use of gas supply pressures of 2 psig (14 kPa) instead of 7 in w.c. (1.75 kPa). This higher supply pressure has many advantages over the lower pressure systems. Since there are fewer fittings and joints, the likelihood of a leak is diminished.

A 2 psig (14 kPa) system increases the gas carrying capacity of the building's piping system, permitting future expansion. The smaller diameter tubing used in 2 psig (14 kPa) systems is ideally suited for the quick-connect gas outlets that make it possible to plug in gas appliances as easily as electric appliances.

GENERAL REQUIREMENTS

Piping Through the Exterior Wall

The piping from the meter to the interior of the building passing through the exterior building wall or foundation must be 1/2 in (13 mm) NPS minimum size and must be firmly anchored or secured to prevent twisting and damaging the connected tubing in the event of work being done on the meter set-up. This can be done by making a change in direction immediately inside the wall using elbows and a nipple and securing the nipple to the structure before transitioning to copper.

The steel piping through the building wall or foundation must be double wrapped with an approved tape, or suitably protected as required in Clause 5.16.8. (See **Corrosion Protection** section.)

ADDITION TO EXISTING STEEL SYSTEMS

When installing add-on appliances to existing systems, **care must be taken to ensure connection to a line supplying the proper pressure for the appliance controls.**

If connecting an appliance to a 2 psig (14 kPa) supply line, a 2 psig/7 in w.c. (1.7 kPa) appliance regulator is required.

Copper systems may be added on to existing 7 in w.c. (1.7 kPa) steel piping systems.

In some cases on new construction, it may be more cost effective to run steel pipe to the furnace and water heater area and use copper tubing for the drops to these appliances and for the runs to other appliances such as the range, dryer, fireplace, etc.

Extensions to and alterations of existing steel/copper systems can be made using copper tubing or steel pipe. Connections may be made using silver soldering, flared fittings, or certain approved types of compression fittings. All extensions, alterations, and connections must be made in accordance with the Code.

In cases where an existing system is extended or upgraded from 7 in w.c. (1.7 kPa) to 2 psig (14 kPa) operating pressure, the pipe sizing of the entire system (not just the extension) must be confirmed. It may also be prudent to retest the entire system at the new operating pressure in accordance with Clause 5.22.4 of the Code.

The interconnection of a steel system and a copper system does NOT cause a corrosion problem as the absence of moisture with the dissimilar metals prevents galvanic action from occurring; however, these interconnections must be in a dry location.

CONVERSION OF EXISTING PROPANE SYSTEMS

If a propane system is to be converted to natural gas, the existing copper system may be used if

the existing copper tubing has been checked for proper size and is adequate to provide the volume of gas required for connected appliances at the supply pressure of 7 in w.c. or 2 psig, as applicable.

A pressure test is required to ensure the system is gas tight, and the lines must be purged to clear any foreign material that may have accumulated during the period the system used propane.

The existing fittings in the system to be converted may remain in use unless leakage is indicated by the pressure test. If any repairs are necessary, then the fittings must be changed to the standard for use with natural gas.

The system must be adequately supported, identified, and protected from corrosion and/or physical damage, as required.

MULTI-FAMILY OR COMMERCIAL MULTI-STOREY BUILDINGS

Piping or tubing installed in multi-family or commercial multi-storey buildings shall be fire stopped as required by the applicable building code.

The tubing must not be installed in contact with other piping, structural steel, and any concrete or masonry. This may be accomplished with an approved isolation material, double wrapping, tubing supports/hangers, or similar means.

Pressure testing should be done both after the tubing installation is completed and after the final construction is complete and the interior walls are in place. The second test is done to assure that no damage occurred to the tubing during the closing-in construction process (drywalling).

Tubing Material

Copper tubing must not exceed 1-1/4 in NPS, and Type G tubing must not be less than 3/8 in NPS. In the majority of installations Type L is recommended for inside use with O.D. size 1/2 in (13 mm) to 3/4 in (19 mm) providing optimum flexibility and usage.

The use of Type L for all multi-family or commercial multi-storey installations is strongly

recommended as the wall thickness is greater than Type G. Type L is not as easily damaged during or after installation by the simultaneous work of the various trades in large construction sites.

Only Type L externally coated with PVC by the copper tube manufacturer or Type K shall be used underground, and any portion rising above ground shall be protected from physical damage by locating it in a protected area such as a building corner, etc, or by providing a protective shield or sleeve over the tubing for the distance required.

The Code requires that copper pipe or tubing must meet ASTM Standard B 75, B 88, or B 280.

TUBING CONNECTIONS

Brazed connections, where used, shall be brazed with a material having a melting point in excess of 1000 °F (525 °C). Some acceptable materials are Allstate 101 FC and Easy Flo 45.

The use of low temperature (tin) soldered connections are prohibited by the Code.

Brazing two lengths of copper tubing together may be done using a manufactured collar or connector or by a swage connection. Where a swage connection is used, the swage must be made with the proper swaging tool and be of the proper size for the tubing being used.

All flare connections used for copper tubing must be the single 45° flare type using the machined long nut. Connections to steel pipe shall be an NPS to flare fitting or NPS to brazed.

In multi-family or commercial multi-storey buildings, all tubing connections, except those connecting to an appliance, are recommended to be of the brazed type; however, flared fittings may be used.

Valves and Shut-offs

The Code specifies acceptable valves for use on a tubing system and provides precautions for their use. Refer to Clauses 5.18, 5.19, and 5.20 for applicable requirements.

System Regulators

The “pounds to inches” system regulator used on 2 psig (14 kPa) systems shall also meet the requirements of the Code. There are a number of regulators available that meet these requirements.

Additional factors that must be considered when selecting and installing a “pounds to inches” system regulator for 2 psig (14 kPa) application are as follows:

- The system regulator must have adequate capacity for the proposed connected load at its minimum inlet pressure (allowing for pressure drop). It should be noted that in many cases a single regulator may be able to serve more than one appliance, depending on the appliance connected loads and relative locations.
- In order for the system regulator to meet the requirements of the Code for 2 psig (14 kPa) use, it may be equipped with an approved ball check leak limiting device, installed in the vertical position so the ball check can function properly (see Clauses 4.1.4 and 4.2.8).

CORROSION PROTECTION

Copper tubing must be protected from corrosion when passing through any outside walls of concrete or masonry. It may be double wrapped with approved tape, coated, or sleeved. A water tight seal must also be provided.

Copper tubing passing through an interior wall of concrete or masonry must be similarly protected; however, a watertight seal is not required.

See Clauses 5.16.6 to 5.16.8 inclusive.

TUBING LOCATION AND PROTECTION

Tubing may run parallel, diagonal, or at a right angle to the floor joists. Tubing that runs parallel to the joist should be fastened to the centre of the vertical face. Tubing that runs diagonal or at a right angle to the joists may be fastened to the underside of the joist, and, where practical, the tubing should be close to the water pipes, conduit, duct work, or centre beams. Tubing run

at a right angle to joists may be installed through holes drilled in the centre of the joist. The diameter of the drilled hole should be at least 1-1/2 times as large as the outside diameter of the tubing.

When installing tubing, a stud, beam, joist, or other structural member must not be cut or notched in such a manner as to reduce its strength below that required for the purpose for which it is intended. Refer to the figure in Clause 5.8 of this handbook for acceptable drilling and notching practices in wood framing.

Tubing that is recessed in a notched stud, joist, plate or other structural member, or that passes through a stud, joist, plate or other structural member where the tubing is less than 1.75 in (43 mm) from an exposed edge, must be protected with a plate of not less than No. 16 GSG (1.59 mm) galvanized sheet steel.

Where the tubing is run through a sleeve providing equivalent protection, the use of the steel plate is not required.

When tubing is run parallel with, and secured to, a stud, joist, plate, or other structural member, it is better practice to locate it a minimum of 1.75 in (43 mm) from the edge of the stud, joist, plate or other structural member. This reduces the likelihood of future punctures by screws or nails that miss the structural member.

Refer to Clause 5.16 of this handbook for an example of tubing location and protection.

TUBING IN PARTITIONS

When copper tubing is installed inside a partition, a metallic sleeve or a steel plate, shall be used to protect the tubing where it passes less than 1.75 in (43 mm) from the edge of the floor or top plate or other structural member of the wall.

If tubing is being run up through an existing partition (enclosed), the enclosed tubing may not contain any connections or fittings within the partition.

CONCEALED LOCATIONS

Concealed piping, tubing, and fittings shall not be installed where they cannot be inspected and tested in their final position prior to being concealed. A union or a combination of fittings designed and intended to act as a swing joint shall not be used where piping or tubing is concealed.

TUBING IDENTIFICATION

All tubing shall be identified where the gas supply enters the building, at a point adjacent to both sides of a wall, floor, or partition and at intervals of not more than 6 ft (2m) along its entire length. Refer to Clause 5.17 for applicable Code requirements.

When piping and tubing are used in a single system and the single system contains both 2 psig pressure and less than 2 psig pressure, it is better practice to identify each one so that they may be easily distinguished.

The tags and labels may be available at no charge from your local gas utility and some wholesale supply outlets.

TUBING DIMENSIONS

Refer to the table provided in Clause 5.3 of this handbook for copper tubing dimensions. Note the difference between nominal tubing size and outside diameter. Typically, 3/8 in to 3/4 in O.D. (10 mm to 19 mm) are the most commonly used in copper tube systems.

TUBING SUPPORT

Tubing systems should be supported according to the requirements of Table 5.8.3.

Tubing may be supported using copper pipe clips or wire U hangers. When installing tubing supports, care must be taken to prevent damage (kinking or flattening) to the tubing. Tubing shall not be supported by other piping or tubing.

Tubing that runs vertically should be supported in the same manner as tubing that runs horizontally.

Copper tubing installed vertically may be

unsupported through a stud wall provided it is properly supported at the floor and ceiling plates. In such cases the hole in a joist or stud or the plate over a notch is considered support.

Good piping practices require the installation of supports adjacent to fittings and connections, and immediately before and after any bends.

All vertical and horizontal tubing shall be independently supported at not more than 6 ft intervals using copper pipe clips, wire U hangers, or other approved means. When installing tubing supports, care must be taken to prevent damage (kicking, flattening) to the tubing. Tubing shall not be supported by other piping and tubing.

Where metal or plastic piping and tubing supports are used, they shall be of a material that has a melting point in excess of 1000 °F (525 °C) and shall be installed to avoid galvanic action between the piping or tubing and the supports.

PRESSURE TESTING

Pressure testing of a system shall be done in accordance with the requirements of the authority having jurisdiction. Remove shut-off valves not rated for the test pressure when applying the pressure test. Subjecting the shut-off valves to elevated pressures will cause them to leak. Appliance shut-off valves rated for, or in excess of, the pressure to be used for the test may be installed and should be in the off position.

CAUTION: *All appliances and equipment MUST be isolated from the test pressure. Under no circumstances is the elevated test pressure permitted against a valve train.*

After all appliances are connected and the gas turned on, a 10 min meter dial test shall be done, and every appliance connection and valve train shall be checked with an approved liquid leak detector solution.

The installers (fitters) shall hang a pressure test tag on the tubing system that they installed and tested showing their name, number, test pressure, and time duration. This pressure test tag is

normally available from the gas utility.

In multi-family or commercial multi-storey buildings where the tubing is concealed, a pressure test shall be completed prior to the concealment of the tubing and shall be completed again after the tubing is concealed (drywall is installed). The installer is responsible for both tests.

After the tubing is concealed and the pressure test indicates a leak is present, ensure all connections for appliances and exposed connections are airtight.

If a leak is still indicated, increase the test pressure significantly (100 psig) and the leak can usually be located because it is audible. Be sure to isolate all components not rated for this pressure. This method keeps the time and cost to a minimum when locating the concealed leak and repairing the damage to the structure.

Tubing Terminations and Appliance Connections

Tubing terminations shall be made in accordance with good piping practices. This may involve an end cap brazed to the end of the tubing or a flared or approved compression end cap fitting. Flattening the end of a tube and brazing it is NOT considered good practice as it may work harden the tubing and could result in cracks.

In systems where 2 psig (14 kPa) house piping pressure is utilized, pressure must be reduced at the appliance by use of a secondary “pounds to inches” regulator meeting local regulatory requirements.

Depending on the number, load, and location of the connected appliances, it may be possible to supply more than one appliance through one “pounds to inches” regulator.

In installations where a 2 psig (14 kPa) regulator serves more than one appliance, two options are available: a manifold may be installed downstream of the regulator and individual piping or tubing lines may be run to the appliances or a standard branch (tree)

distribution system may be used to the appliances.

All piping or tubing downstream of the “pounds to inches” secondary regulator must be sized at the pressure at which it will be operating.

Where copper tubing is run directly to an appliance that is prone to vibration, the tubing should be firmly fixed and a standard appliance flex connector used to make the final appliance connection.

All connections using copper tubing shall be adequately supported.

Fixed appliances such as furnaces, boilers, and water heaters may be directly connected with tubing from the appliance shut-off valve to the appliance. Where this is done, the tubing should be secured to the appliance casing or otherwise secured to avoid physical damage or movement.

Supply lines to moveable appliances such as ranges and dryers shall be rigidly fixed, and the appliance shall be connected with a flexible metal connector to allow the appliance to be moved as required.

APPLIANCE MANUAL SHUT-OFF VALVES

Appliance manual shut-off valves are required for each appliance and are to be readily accessible.

Shut-off valves used are usually of the plug or ball type and must be certified and acceptable for the pressure for which they will be used.

Depending upon cost, it is recommended that appliance shut-off valves of the ball type be used where the pressure rating of the shut-off valve is equal to, or in excess of, the pressure to be used for the pressure test. Where this is the case, the system then may be pressure tested with the shut-off valve installed, thus reducing the time and cost of installation. The savings on installation can be in excess of the cost of the shut-off valves.

An appliance shut-off valve to an appliance (range, dryer) located on a floor above a basement may be located in the basement if such

a location is readily accessible as defined in the Code.

The appliance shut-off valves may be installed in either the drop or riser of the appliance or within a maximum of 50 ft (17 m) of the appliance that it serves. Where an appliance shut-off valve is not on the drop or riser, it is to be identified by either an attached metal tag or by a permanent, clearly legible sign immediately near the valve.

In some installations, the use of a master manifold may be preferable to locating the appliance shut-off valves at each appliance. An example of a master manifold is illustrated on the following page.

This manifold system may also be used with the shut-off valves installed on the drop or riser to each appliance.

APPLIANCE CONNECTIONS

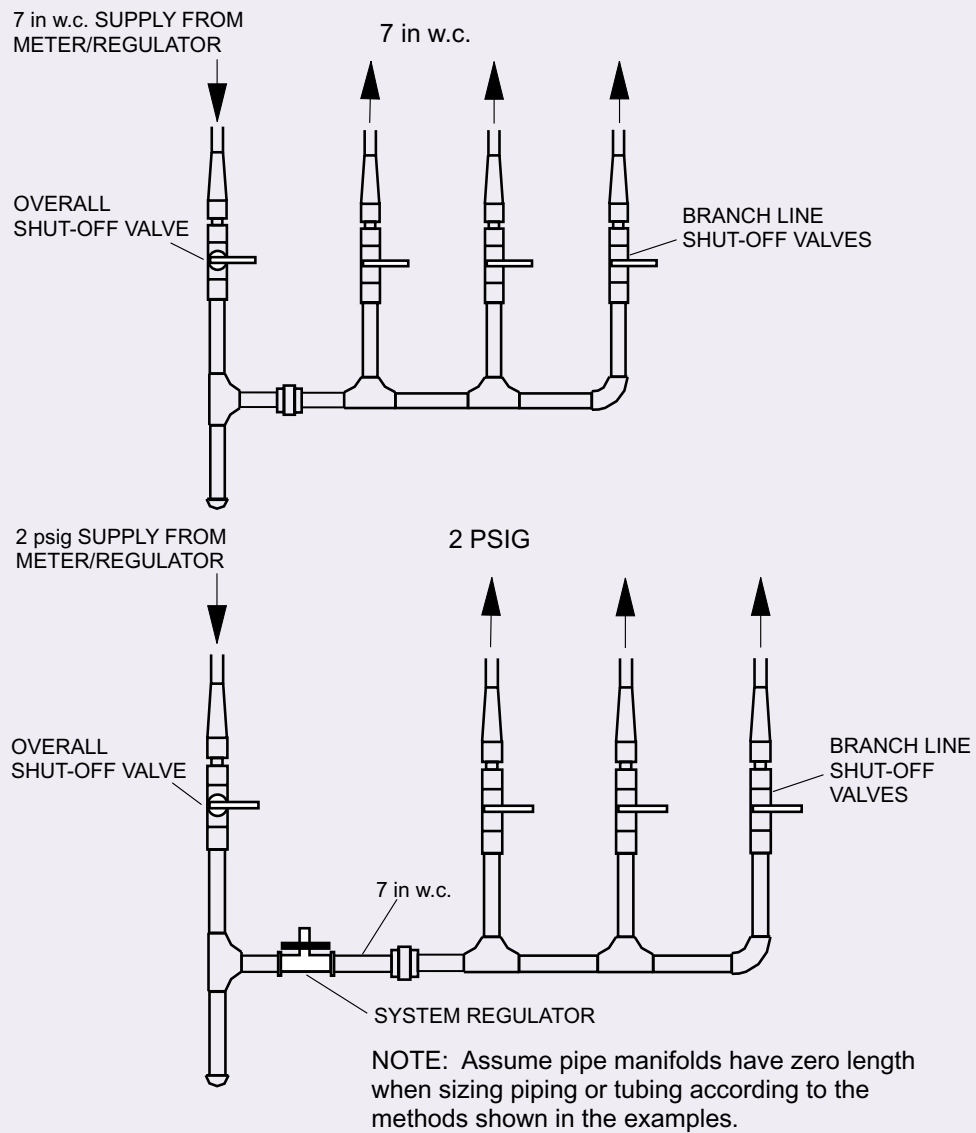
Appliances such as furnaces, boilers, and water heaters may be connected with tubing running directly from the appliance shut-off valve to the dirt pocket on the appliance. Where this is done, the tubing is to be strapped to the appliance casing or attached to the structure in such a manner as to resist physical damage or movement.

Appliances such as ranges and dryers are connected to the supply tubing with either a copper coil or a flexible metal connector, and the supply tubing must be rigidly attached to the structure to prevent movement and physical damage.

Decorative appliances may be connected with tubing. The supply tubing to the appliance shut-off valve or appliance shall be rigidly attached to the structure to prevent movement and physical damage.

When connecting copper tubing to an appliance, and the appliance shut-off valve is to be installed at the appliance, be sure to install a steel union between the appliance shut-off valve and the manifold. Experience has shown that the union has been forgotten many times, even by experienced installers of copper systems.

EXAMPLES OF MANIFOLD SYSTEMS



INSTALLATION OF 7 in w.c. (1.75 kPa) SYSTEMS

RESIDENTIAL AND SMALL COMMERCIAL METER SETS

The standard residential 7 in w.c. (1.75 kPa) meter set is used.

PRESSURE DROP

The maximum allowable pressure drop in a system is 1 in w.c. (0.25 kPa) where the supply pressure is 7 in w.c. (1.75 kPa) or greater at the service regulator.

Where the supply pressure is less than 7 in w.c. (1.75 kPa), the maximum pressure drop allowed is 0.5 in w.c. (125 Pa). This condition may be found in areas where the gas supply from the street main is low pressure. A meter set up without a service regulator is usually a low street pressure system. When unsure of the supply pressure, check with your local gas utility.

TUBING SIZING

7 in w.c. (1.75 kPa)

The maximum capacity of copper tubing for 7 in w.c. (1.75 kPa) supply pressure with a pressure drop of 1 in w.c. (0.25 kPa) is shown in the table below. This may be used as an approximate guide when checking tubing size. Actual sizing may be performed using Table A.2 in Appendix A of the Code.

MAXIMUM LENGTH OF COPPER TUBING SERVING APPLIANCES

Supply Pressure 7 in w.c.

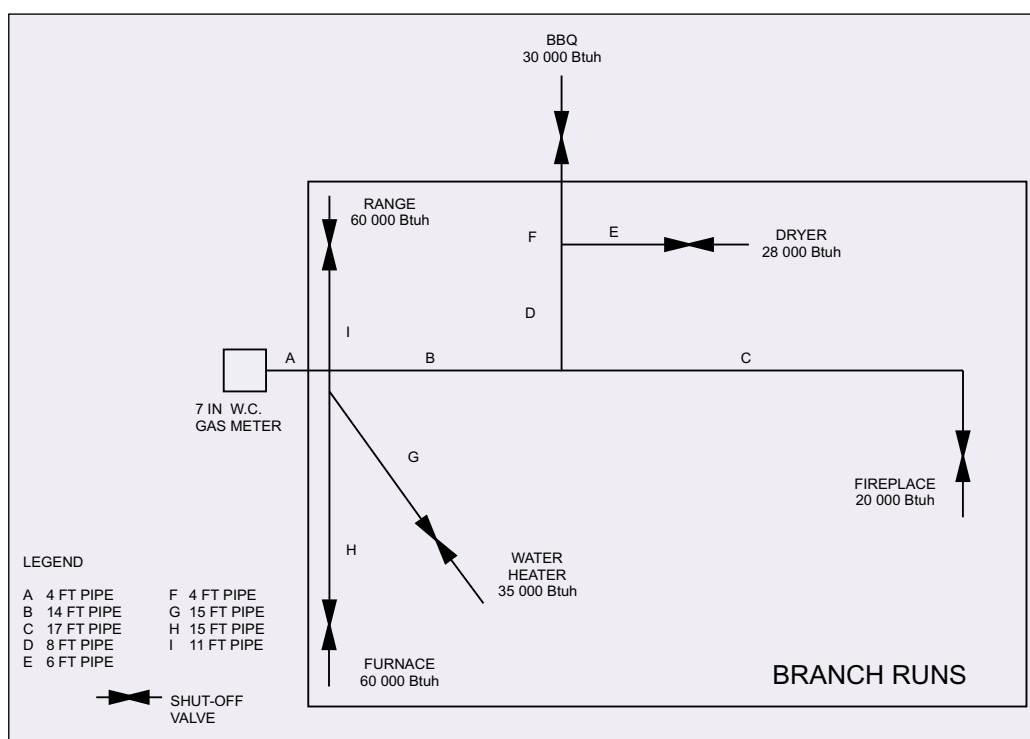
APPLIANCE	INPUT	TUBING SIZE	
		1/2 in OD	5/8 in OD
Furnace	90 000 Btuh/90 cfh	10 ft	30 ft
Water Heater	35 000 Btuh/35 cfh	50 ft	150 ft
Dryer	30 000 Btuh/30 cfh	65 ft	200 ft
Range	60 000 Btuh/60 cfh	20 ft	60 ft
BBQ	30 000 Btuh/30 cfh	65 ft	200 ft
Fireplace	30 000 Btuh/30 cfh	65 ft	200 ft

Note: The maximum length in this table is the total distance from the meter to the appliance. These values and capacities are approximations and may not be the exact values shown in Table A.2 in Appendix A of the Code.

EXAMPLE 3 — NATURAL GAS TUBING SIZING PROCEDURE FOR 7 in w.c. (1.75 kPa) SYSTEM USING BRANCH RUNS

In this example, the longest run of tubing is used to size all of the tubing. The longest run is 35 ft from the meter to the fireplace. The 40 ft length from Table A.9 must be used.

The results are summarized in the table at the bottom of this page.



Section	Description	Sizing	
H	branch to furnace	total demand = 60 000 Btuh; use 5/8 in O.D.	All branches sized using Table A.9 and 40 ft length of tube
G	branch to water heater	total demand = 35 000 Btuh; use 5/8 in O.D.	
F	branch to BBQ	total demand = 30 000 Btuh; use 1/2 in O.D.	
E	branch to dryer	total demand = 28 000 Btuh; use 1/2 in O.D.	
D	branch to E and F	total demand = 58 000 Btuh; use 5/8 in O.D.	
C	branch to fireplace	total demand = 20 000 Btuh; use 1/2 in O.D.	
B	branch to C and D	total demand = 78 000 Btuh; use 3/4 in O.D.	
A	meter to all branches	total demand = 233 000 Btuh; use 1-1/8 in O.D.	

EXAMPLE 4 — NATURAL GAS TUBING SIZING PROCEDURE FOR 7 in w.c. (1.75 kPa) SYSTEM USING INDIVIDUAL RUNS

When individual runs are used, each section must be sized using the length of run from the meter set to the individual appliance being served, and the total load it must deliver. Table A.9 is used for sizing.

1. Section A:

The longest run served by the tubing connected to the meter is 35 ft, and the total load is 233 000 Btuh. Use 1-1/8 in O.D. tubing.

2. To size section B:

Meter to fireplace = 31 ft + 4 ft (A) = 35 ft

Load is 20 000 Btuh

B = 1/2 in O.D.

3. To size section C:

Meter to dryer = 23 ft + 4 ft (A) = 27 ft

Load is 28 000 Btuh

C = 1/2 in O.D.

4. To size section D:

Meter to BBQ = 20 ft + 4 ft (A) = 24 ft

Load is 30 000 Btuh

D = 1/2 in O.D.

5. To size section E:

Meter to water heater = 15 ft + 4 ft (A) = 19 ft

= 19 ft

Load is 35 000 Btuh

E = 1/2 in O.D.

6. To size section F:

Meter to furnace = 15 ft + 4 ft (A) = 19 ft

Load is 60 000 Btuh

F = 5/8 in O.D.

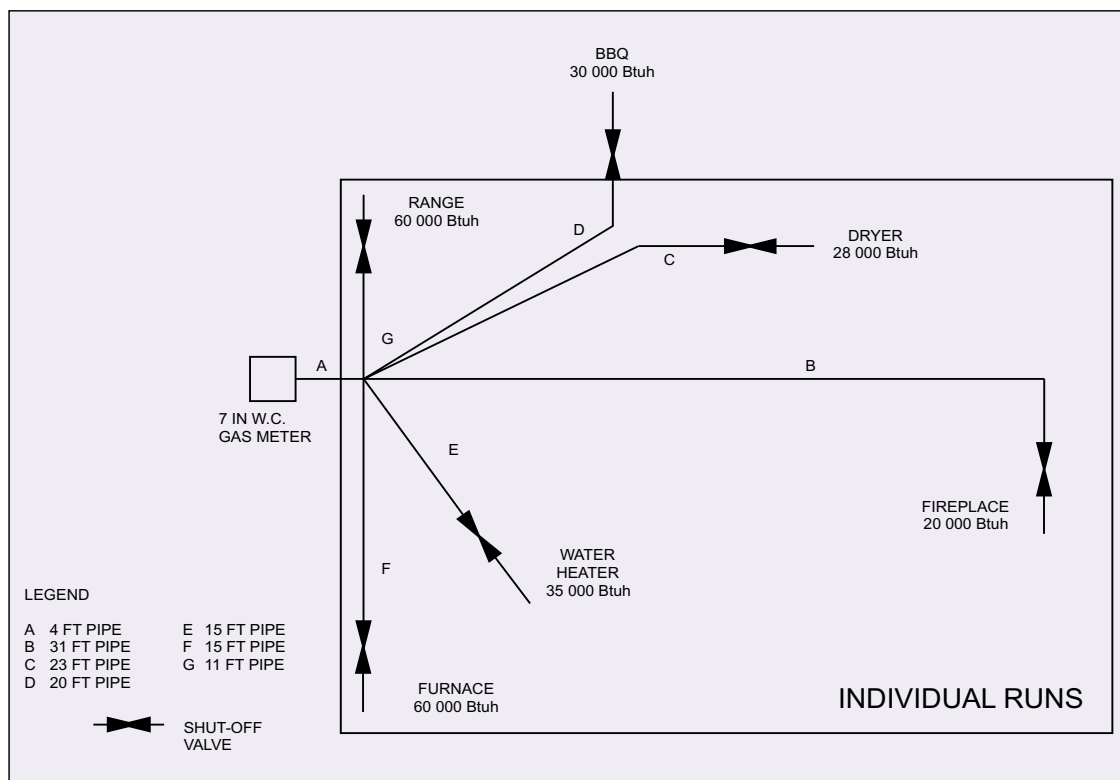
7. To size section G:

Meter to range = 11 ft + 4 ft (A) = 15 ft

Load is 60 000 Btuh

G = 5/8 in O.D.

A comparison of this example with Example 3 shows that individual runs generally result in smaller tubing sizes than branch runs.



INSTALLATION OF 2 PSIG (14 kPa) SYSTEMS**RESIDENTIAL AND SMALL COMMERCIAL METER SET-UPS**

If 2 psig (14 kPa) pressure is to be supplied to a customer, the standard residential 14 kPa - 2 PSIG - PFM meter set is used.

Where more than one meter is required at a location, contact the local gas utility for more details, as alternate meter set-ups are available for these applications.

A contractor/installer/builder must contact the local gas utility prior to installing a 2 psig system.

IDENTIFICATION OF 14 kPa - 2 PSIG - PFM SERVICE SET-UP

Depending on the requirements of the authority having jurisdiction, it may be necessary to identify

the service regulator serving a 14 kPa - 2 PSIG - PFM system with a yellow marking on the regulator spring column and a yellow marking on the meter.

SERVICE REGULATOR/METER

These are normally installed by the gas utility.

SYSTEM REGULATOR

A certified system regulator must be installed in accordance with applicable Code requirements.

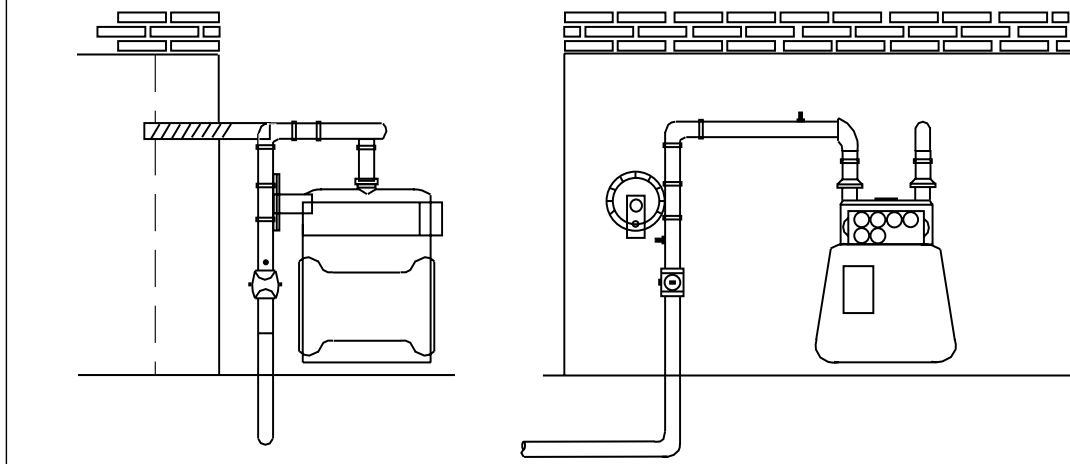
PRESSURE DROP

The maximum allowable pressure drop in a 2 psig (14 kPa) system is 1 psig (7 kPa).

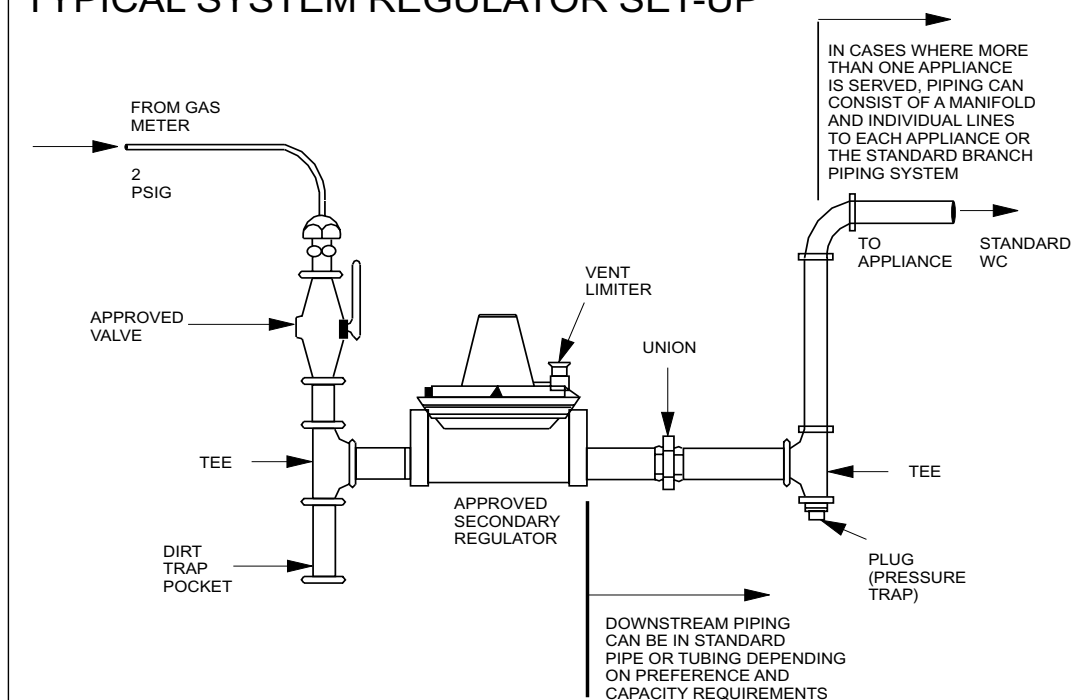
TUBING SIZING — 2 PSIG (14 kPa)

The maximum capacity of copper tubing for 2 psig (14 kPa) supply pressure with a pressure drop of 1 psig (7 kPa) may be determined using Table A.10 in Appendix A.

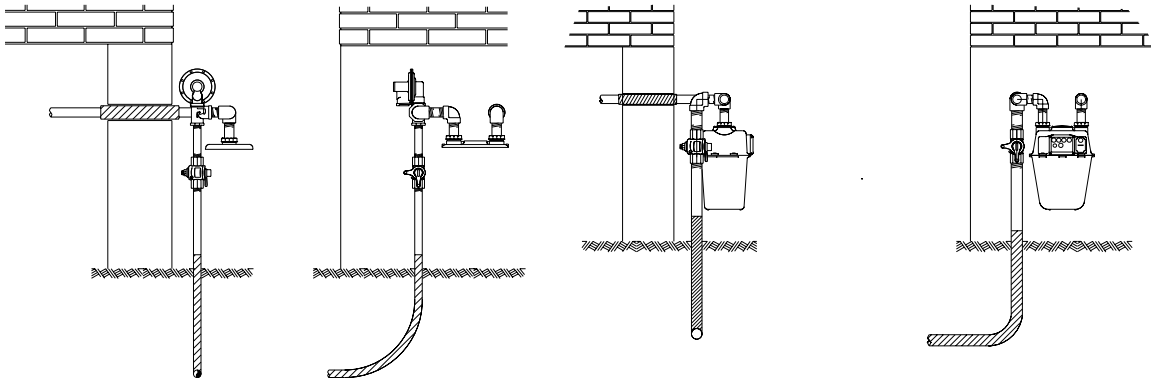
STANDARD RESIDENTIAL 2 psig (14 kPa) PFM METER SET-UP



TYPICAL SYSTEM REGULATOR SET-UP

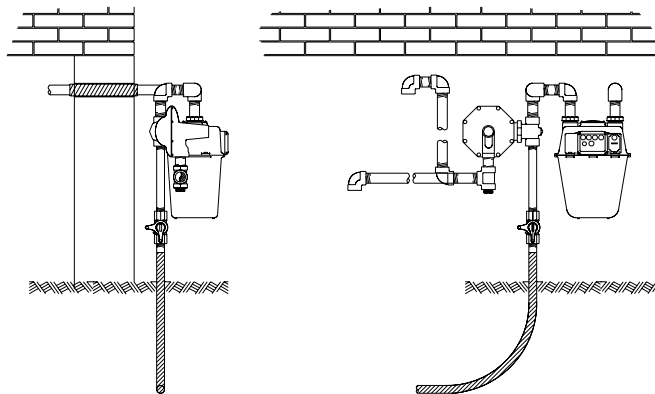


TYPICAL NATURAL GAS METER INSTALLATIONS

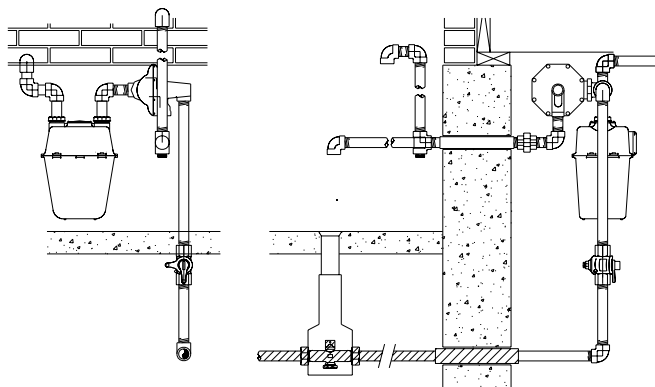


Typical natural gas meter plate installation requiring a service regulator. This type of installation commonly occurs in new construction, prior to completion of gas servicing to a newly developed area.

Typical gas meter installation in an area with low street main pressures. Due to low pressures, a service regulator is not installed. This type of installation normally occurs in areas with older natural gas service.



Current, typical gas meter installation requiring a service regulator. Note the options for locating the service regulator vent in a permitted area.



Typical indoor gas meter installation requiring a service regulator. Service regulator must be vented to outside according to options shown.

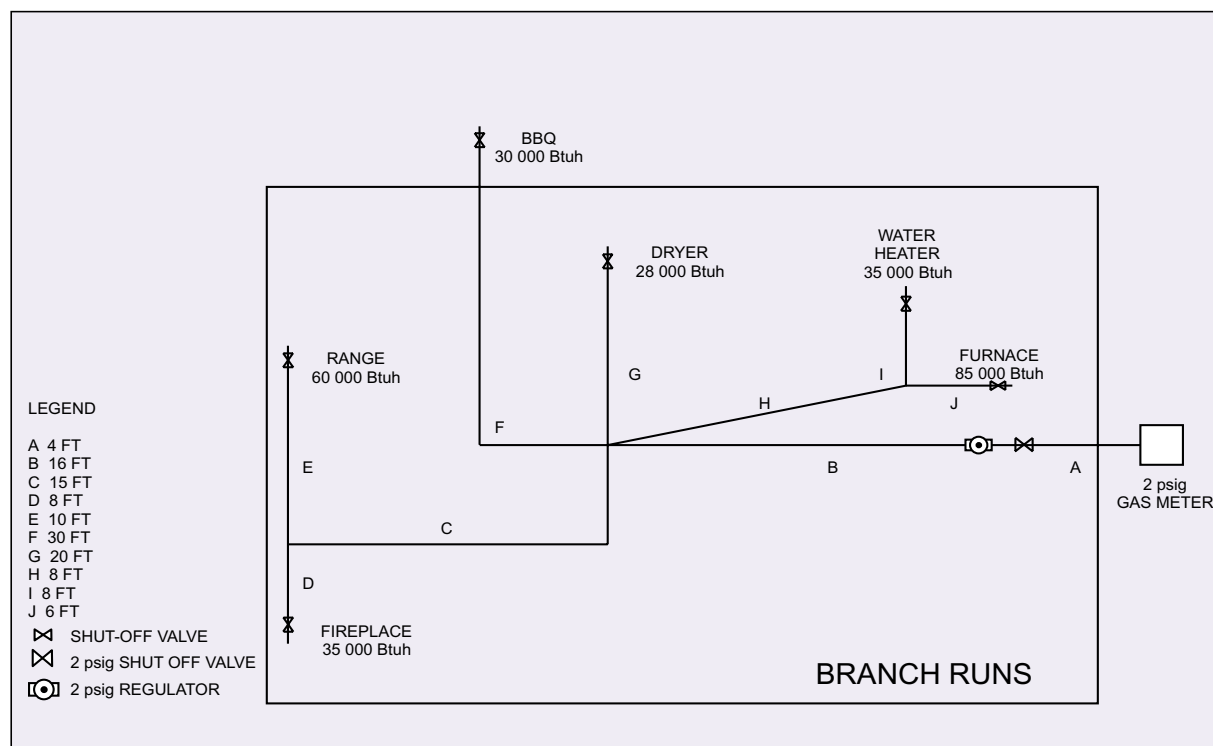
EXAMPLE 5 — NATURAL GAS 2 PSIG (14 kPa) SYSTEM WITH SYSTEM REGULATOR USING BRANCH RUNS FOR 7 in w.c.

In this example, the tubing from the meter set to the system regulator is sized separately using Table A.10.

To size low pressure (7 in w.c.) sections, consider the 2 psig regulator to be the source rather than the meter. The longest run of tubing from the

system regulator is used to size all of the tubing downstream of the system regulator. The longest run is 46 ft from the system regulator to the BBQ. The 50 ft length from Table A.9 must be used.

Note: In some applications it may be found that a 2 psig system is impractical and/or unnecessary and a 7 in w.c. system is adequate and acceptable. In such cases, size the entire system from the meter using Table A.9 (see Example 3).



Section	Description	Sizing	
J	branch to furnace	total demand = 85 000 Btuh; use 3/4 in O.D.	All branches sized using Table A.9 and 50 ft length of tube
I	branch to water heater	total demand = 35 000 Btuh; use 5/8 in O.D.	
H	branch to I and J	total demand = 120 000 Btuh; use 7/8 in O.D.	
G	branch to dryer	total demand = 28 000 Btuh; use 1/2 in O.D.	
F	branch to BBQ	total demand = 30 000 Btuh; use 1/2 in O.D.	
E	branch to range	total demand = 60 000 Btuh; use 5/8 in O.D.	
D	branch to fireplace	total demand = 35 000 Btuh; use 5/8 in O.D.	
C	branch to D and E	total demand = 95 000 Btuh; use 3/4 in O.D.	
B	system regulator to all branches	total demand = 273 000 Btuh; use 1-1/8 in O.D.	
A	meter to system regulator	total demand = 273 000 Btuh; from Table A.10, use 1/2 in O.D.	

EXAMPLE 6 — NATURAL GAS SIZING PROCEDURE FOR 2 PSIG (14 kPa) SYSTEM WITH SYSTEM REGULATOR USING INDIVIDUAL RUNS FOR 7 in w.c.

In this example, the tubing from the meter set to the system regulator is sized separately using Table A.10. To size low pressure (7 in w.c.) sections, consider the 2 psig regulator to be the source rather than the meter. Each section must be sized using the length of run from the system regulator to the individual appliance being served and the total load it must deliver. Table A.9 is used for sizing.

1. Section A:

The length of run from the meter set to the system regulator is 4 ft, and the total load is 273 000 Btuh. Use 1/2 in O.D. tubing.

2. To size section B:

Use the total connected load and the longest run from the system regulator to the BBQ.
Regulator to BBQ = 26 ft + 16 ft (B) = 42 ft
Load is 273 000 Btuh
B = 1-1/8 in O.D. from Table A.9

3. To size section C:

Regulator to fireplace = 21 ft + 16 ft (B)
= 37 ft

Load is 35 000 Btuh
C = 5/8 in O.D.

4. To size section D:

Regulator to range = 15 ft + 16 ft (B) = 31 ft
Load is 60 000 Btuh
D = 5/8 in O.D.

5. To size section E:

Regulator to BBQ = 26 ft + 16 ft (B) = 42 ft
Load is 30 000 Btuh
E = 1/2 in O.D.

6. To size section F:

Regulator to dryer = 20 ft + 16 ft (B) = 36 ft
Load is 28 000 Btuh
F = 1/2 in O.D.

7. To size section G:

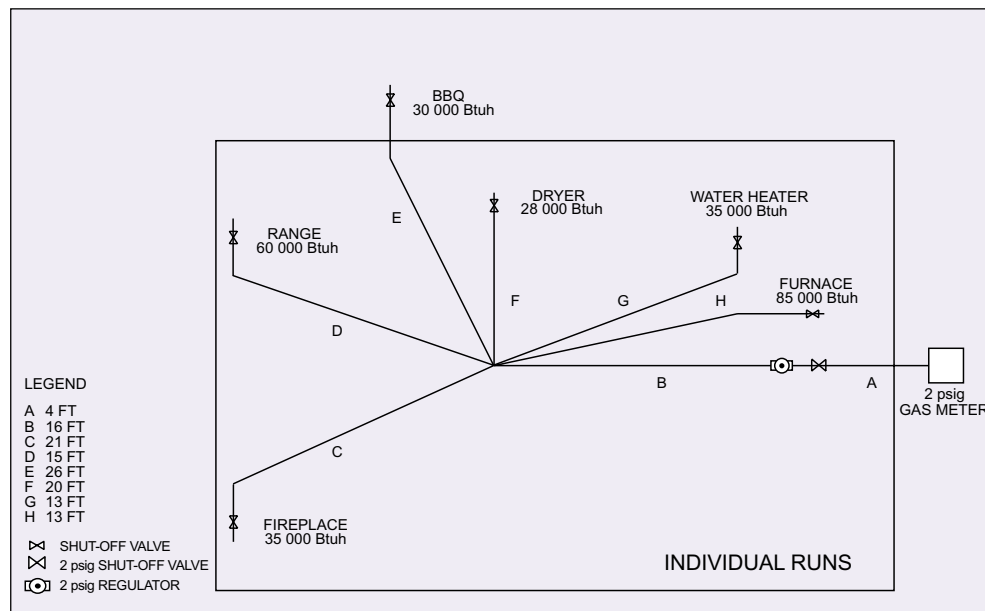
Regulator to water heater = 13 ft + 16 ft (B)
= 29 ft

Load is 35 000 Btuh
G = 1/2 in O.D.

8. To size section H:

Regulator to furnace = 13 ft + 16 ft (B)
= 29 ft

Load is 85 000 Btuh
H = 3/4 in O.D.



2 PSIG REGULATOR

A pressure regulator is required at each appliance or combination of appliances to reduce 2 psig (14 kPa) to 7 in w.c. (1.7 kPa). This regulator, when applied in accordance with this procedure, has a maximum capacity of 300 cfh. The total input of the appliance or appliances that it serves shall not exceed 300 cfh (300 000 Btuh).

The regulator is designed to operate when installed in any position; however, when equipped with an automatic safety vent limiting device (leak limiter), containing a ball check, for use on 2 psig (14 kPa), the regulator must be installed in the system with the regulator body in a horizontal position and the spring column in the vertical position. This position automatically puts the leak limiter in the vertical position.

Blow inlet piping free of chips and possible debris before connecting to the regulator. **DO NOT** blow lines through the regulator. Chips on the regulator valve seat must be avoided as they prevent tight lockup; as a result, system downstream pressure can rise to 2 psig (14 kPa) and appliance valves will not open. (They are designed to respond this way.)

Most appliances have their own regulator, reducing pressure from 7 in w.c. (1.7 kPa) house pressure to approximately 3–5 in w.c. (0.75–1.25 kPa) manifold pressure. You must continue to use this regulator. The use of a 2 psig (14 kPa) regulator does not make the appliance regulator unnecessary.

AUTOMATIC SAFETY VENT LIMITING DEVICE

This is an orificed leak limiter equipped with a ball check for use on appliance regulators for 2 psig (14 kPa) systems. The orifice size limits the maximum escapement rate to 1 cfh at an inlet pressure of 2 psig (14 kPa) upon diaphragm rupture. The ball check improves the speed of response of the regulator and is usually identified by the green colour coding.

The leak limiter device must be installed in the threaded opening of the regulator. Do not install

any type of piping between the limiter and the regulator. If the limiter is not in the regulator on the top side, it may cause pressure problems.

Do not leak test the vent limiter with liquid leak test solution. You will contaminate the internal ball check mechanism or plug the breathing hole, resulting in erratic regulator operation.

Remove the limiter and check the vent opening if a leaking diaphragm is suspected. Remember, regulators will “breathe” when regulating, creating a bubble; a leak will blow bubbles constantly.

2 PSIG MANUAL SHUT-OFF VALVES

The manual shut-off valve(s) used on 2 psig (14 kPa) should be a certified lever handle ball or an approved equivalent and shall be installed immediately upstream of the regulator.

The 1/2 in NPS (13 mm) lever handle ball valve is acceptable for use with 2 psig (14 kPa) tubing sizes up to and including 3/4 in NPS (19 mm).

LOCATION OF 2 PSIG MANUAL SHUT-OFF VALVE(S)

Where a meter serves only one 2 psig (14 kPa) tubing system, a shut-off valve downstream of the meter immediately inside the structure (basement) is not required where the meter shut-off valve is readily accessible and easily identified. Where several tubing systems are supplied, a shut-off valve shall be installed for each system immediately inside the structure (ie, tubing individually to furnace, water heater, range, dryer).

The 2 psig (14 kPa) ball valve shall be installed immediately ahead of the 2 psig (14 kPa) regulator with an iron pipe dirt pocket between the ball valve and the regulator. If the regulator serves only one appliance, an appliance shut-off valve downstream of the regulator or on the drop or riser to the appliance is not required.

A 2 PSIG MANIFOLDED SYSTEM

2 psig manifolded systems, as shown on page 88, are to be installed with a dirt pocket

between the ball valve and the system regulator. This acts not only as a dirt pocket but also as a gauge connection to check the upstream pressure in the event of operational problems.

A similar gauge connection should also be provided on the low pressure side (7 in w.c.) of the manifold for checking downstream pressure. Such a connection is not required where the regulator serves only one appliance shut-off valve on the manifold; a gauge connection is not required as a pressure test can be taken using any one of the appliance connections.

The location of the appliance shut-off valves on the manifold allows pressure testing without shutting off the entire system. On multiple appliance manifolds, a union will be required between the regulator and the manifold to allow for changing of the regulator if required.

The immediate piping downstream of the regulator should be a length equal to 10 pipe diameters before changing direction or connecting to the manifold. If the piping from the regulator is 1/2 in then the length of the piping downstream of the regulator should be a minimum of 5 in before installing the manifold or changing direction.

REGULATOR SERVICE PROBLEMS AND CORRECTIONS

Proper servicing requires manometers or pressure gauges to be installed both upstream and downstream of the “pounds to inches” regulator. **DO NOT GUESS!**

Problem 1:

The regulator satisfactorily controls downstream pressure to the appliance while the burner is on, but allows the pressure downstream to creep up towards 2 psig (14 kPa) when off. The furnace won't come on when the thermostat calls; the valve is energized and may buzz but no gas flows.*

Cause/Cure:

The regulator seat is dirty; replace the regulator. Be certain to blow the gas line between the meter and the 2 psig (14 kPa) regulator to clean out any remaining foreign material.

Problem 2:

Downstream pressure is OK when a single appliance is on, but drops drastically (below 4 in w.c.) (1.0 kPa) when other appliances come on.*

Cause/Cure:

The system is overloaded. Check the total load, pipe size for this load, and any restrictions in the piping system (kinked or bent tubing). Remember piping between the meter and the “pounds to inches” regulator must be sized for no more than a 1 psig drop (6.9 kPa).

Problem 3:

The appliance experiences improper ignition characteristics (delayed ignition, banging at times, etc.) The pressure drops drastically when a load is applied and slowly rises to normal. The downstream pressure rises to more than 12 in w.c. (3.0 kPa) when appliances are shut off.

Cause/Cure:

The vent limiter is dirty or restricted. Temporarily remove the vent limiter and check operation of the system. If operation is OK, replace the vent limiter.

* A bounce in downstream pressure of 2 to 5 in w.c. (0.5 to 1.25 kPa) when appliances are shut off is normal. Higher bounces result in high pressures in downstream gas lines and may prevent the appliance's automatic valve from opening. High bounce can be caused by undersizing piping systems or dirty vent limiters.

Summary:

The capacity of the pressure regulator depends upon flowing inlet pressure. This pressure is determined by the gas flow, the length of the run, and the internal pipe or tubing diameter. The shorter the run, the lower the drop. The lower the flow, the lower the drop.

PROPANE PIPING SYSTEMS

This section provides some basic considerations for propane piping and tubing installations, along with sizing examples. All requirements may be found in Clause 5 of the B149.1 Code.

SYSTEM PLANNING

When planning the piping system, the first consideration is the location of the tank or cylinder(s). This topic is not covered in this handbook; however, ensure that all Code requirements are met. Also remember that the tank or cylinder(s) must be accessible at all times of the year.

TEMPORARY INSTALLATIONS

In some cases, a temporary installation is required. While single-stage pressure regulation is permitted by the Code, two-stage pressure regulation is recommended.

REGULATOR SELECTION

Regulators must be sized to ensure adequate delivery of the total connected load. Use the appropriate inlet and outlet pressures, and the manufacturer's regulator performance charts to correctly size all regulators. Make sure that the regulator is a type that has a full relief vent.

LINE RELIEF VENTING

Line relief devices must always be vented to the outdoors. The termination of all line relief vents must not cause a hazard, and must be protected from the weather and insects. A vent shield is normally used to accomplish this. When the regulator serves a long run of piping or tubing having a large connected load, a suppressor may be used to dampen diaphragm chatter. It also serves as a weather and insect shield.

PIPE SIZING

Pipe and tubing sizing may be performed using the applicable tables in Appendix B of the B149.1 Code. The available tables have been summarized below. Note that while the same principles for branch and individual run sizing apply to both natural gas and propane, the correct tables for each of these fuels must be used.

PRESSURE TESTING

Perform all required pressure testing in accordance with applicable Code requirements. Make sure the piping is adequately protected and identified.

SUMMARY OF PIPING AND TUBING SIZING TABLES FOR PROPANE IN APPENDIX B OF THE B149.1 CODE

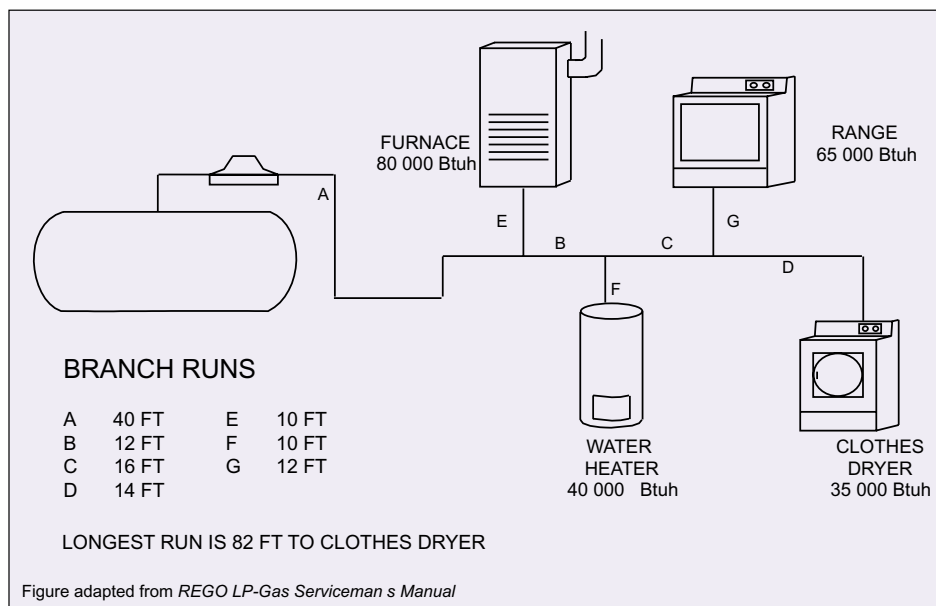
Units	Absolute Pressure	Allowable Pressure Drop	Pipe or Tube Type	Appendix B Table Pipe or Copper Tube
Imp	11 in w.c.	1 in w.c.	Schedule 40 pipe or copper	B.1 or B.6
SI	2.7 kPa	250 Pa	Schedule 40 pipe or copper	B.1(M) or B.6(M)
Imp	2 psig	1 psig	Schedule 40 pipe or copper	B.2 or B.7
SI	14 kPa	7 kPa	Schedule 40 pipe or copper	B.2(M) or B.7(M)
Imp	5 psig	2.5 psig	Schedule 40 pipe or copper	B.3 or B.8
SI	34 kPa	17 kPa	Schedule 40 pipe or copper	B.3(M) or B.8(M)
Imp	10 psig	5 psig	Schedule 40 pipe or copper	B.4 or B.9
SI	70 kPa	35 kPa	Schedule 40 pipe or copper	B.4(M) or B.9(M)
Imp	20 psig	10 psig	Schedule 40 pipe or copper	B.5 or B.10
SI	140 kPa	70 kPa	Schedule 40 pipe or copper	B.5(M) or B.10(M)

EXAMPLE 7 — PROPANE COPPER TUBING SIZING PROCEDURE FOR 11 in W.C. (2.7 kPa) SINGLE-STAGE REGULATOR SYSTEM USING BRANCH RUNS

In this example, the longest run of tubing is used to size all of the tubing. The longest run is 82 ft from the single-stage regulator to the clothes dryer.

The 90 ft length from Table B.6 must be used for all tubing runs.

Note that single-stage pressure regulation is not recommended, but is permitted for temporary installations only.

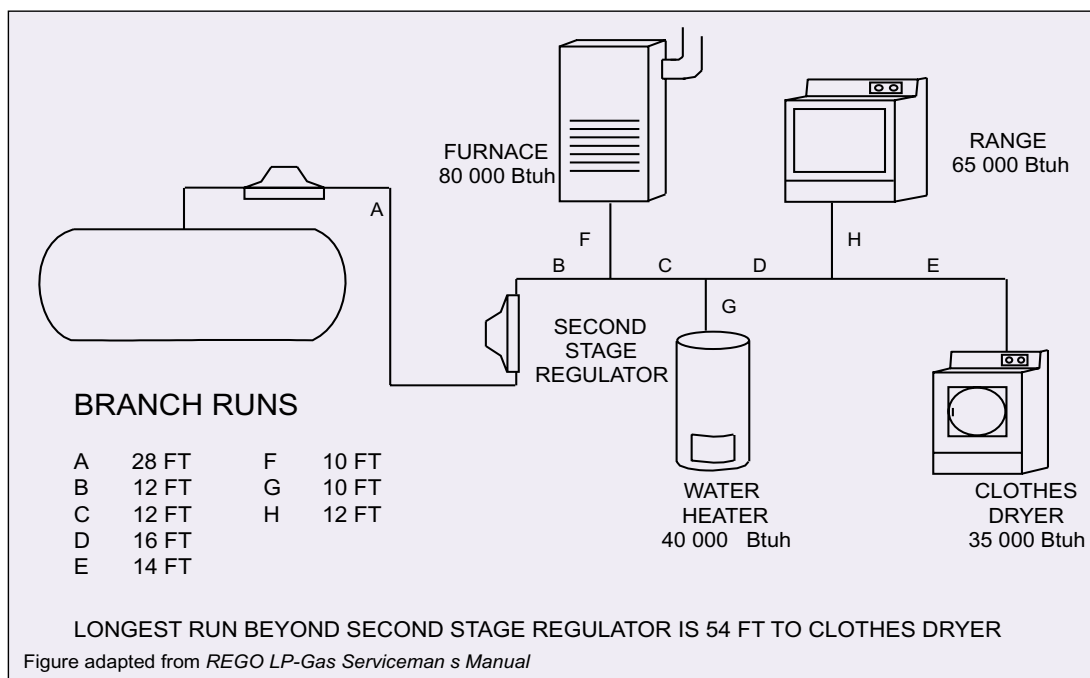


Section	Description	Sizing	
G	branch to range	total demand = 65 000 Btuh; use 5/8 in O.D.	All branches sized using Table B.6 and 90 ft length of tube
F	branch to water heater	total demand = 40 000 Btuh; use 5/8 in O.D.	
E	branch to furnace	total demand = 80 000 Btuh; use 3/4 in O.D.	
D	branch to clothes dryer	total demand = 35 000 Btuh; use 1/2 in O.D.	
C	branch to D and G	total demand = 100 000 Btuh; use 3/4 in O.D.	
B	branch to C and F	total demand = 140 000 Btuh; use 7/8 in O.D.	
A	regulator to all branches	total demand = 220 000 Btuh; use 1-1/8 in O.D.	

**EXAMPLE 8 — PROPANE COPPER
TUBING SIZING PROCEDURE FOR
10 PSIG (70 kPa) FIRST-STAGE
REGULATOR TO 11 in W.C. (2.7 kPa)
SECOND-STAGE REGULATOR
SYSTEM USING BRANCH RUNS**

To size low pressure (11 in w.c.) sections, consider the second-stage regulator to be the source. The longest run of tubing from the system regulator is used to size all of the tubing downstream of the system regulator. The longest run is 54 ft from the second-stage regulator to the dryer. The 60 ft length from Table B.6 must be used to size all of the runs.

In this example, the tubing from the first-stage regulator to the second-stage regulator is sized separately using Table B.9.



Section	Description	Sizing	
H	branch to range	total demand = 65 000 Btuh; use 5/8 in O.D.	All branches sized using Table B.6 and 60 ft length of tube
G	branch to water heater	total demand = 40 000 Btuh; use 1/2 in O.D.	
F	branch to furnace	total demand = 80 000 Btuh; use 5/8 in O.D.	
E	branch to clothes dryer	total demand = 35 000 Btuh; use 1/2 in O.D.	
D	branch to D and G	total demand = 100 000 Btuh; use 3/4 in O.D.	
C	branch to C and F	total demand = 140 000 Btuh; use 3/4 in O.D.	
B	regulator to all branches	total demand = 220 000 Btuh; use 7/8 in O.D.	
A	first to second stage regulator	total demand = 220 000 Btuh; from Table B.9, use 3/8 in O.D.	

6. INSTALLATION OF SPECIFIC TYPES OF APPLIANCES

Clause 6 provides requirements for the installation of specific types of appliances. Due to the large number and variety of gas appliances available, the requirements in Clause 6 should be viewed as largely generic in nature, and limited to the general types of appliances commonly installed. A summary table of minimum clearances for the appliances listed in Clause 6 has been provided at the end of this chapter for convenient reference. More accurate information may be found by referring to the manufacturer's certified installation instructions for the appliance being installed.

Before proceeding with any installation, it is useful to review the general requirements in Clause 3 that are applicable to the appliance being installed. As well, Clause 5 should be reviewed for relevant supply piping requirements and Clause 7 carefully examined for the appropriate venting requirements. Taking the time to correctly identify all of the applicable requirements pertaining to an appliance installation makes it easier to develop a proper plan. Following these suggestions will result in a more economical and efficient execution of installations, while ensuring that the installation is appropriately integrated with existing and reasonably foreseeable systems.

Key Points

- Clause 6 provides general requirements for specific types of appliances.
- Review the appliance manufacturer's certified installation instructions for detailed information.
- Refer to the general requirements applicable to the appliance being installed in Clause 3.
- Consider piping and venting requirements in Clauses 5 and 7 when planning the installation.

6. INSTALLATION OF SPECIFIC TYPES OF APPLIANCES

6.1 Boilers

Intent and Rationale — Clause 6.1

The intent of Clause 6.1 is to ensure that boilers, which must be certified in accordance with the applicable provincial Boiler and Pressure Vessel Regulations, are properly installed with safe clearances to combustible materials.

The rationale for these requirements is conveyed or referenced within the requirements themselves.



Looking Back

For detailed information regarding the installation of central furnaces on combustible floors, refer to Clause 3.13.3.

needed for proper operation, must be equipped with a low pressure cut-off device of the manual reset type. Similarly, pressure boosters that can over-pressurize the downstream system by more than 20% of the normal operating pressure must be equipped with a mechanical bypass, as well as a high pressure switch, both of which can be set to prevent the 20% over-pressure threshold from being exceeded. The potential problems associated with over-pressurization justify the requirement for more than one means of control. The 20% over-pressurization limit represents the allowable threshold for typically connected appliances.



Better Practice

Prior to proceeding with any appliance installation, review the general requirements pertaining to the appliance in Clause 3 of this handbook. A review of Clauses 5 and 7 to determine applicable supply piping and venting requirements is also recommended. By following these suggestions, appliance installations may be more efficiently planned and performed.

6.2 Pressure Boosters — for Natural Gas Only

Intent and Rationale — Clause 6.2

The intent of this Clause is to minimize safety hazards associated with the leakage of gas or the excessive fluctuation of gas pressure in pressure boosters or similar equipment.

The risk of fire or explosion arising from leakage-susceptible pressure booster equipment is minimized by requiring the provision of ventilation air that will serve to dilute the concentration of gas in spaces occupied by such equipment. Hermetically sealed equipment is not considered leakage-susceptible, and it is also limited in capacity; hence it is exempted from this requirement. Pressure boosters, capable of creating a reduced gas pressure and starving appliances of the rate of gas flow

6.3 Carbon Dioxide Generators

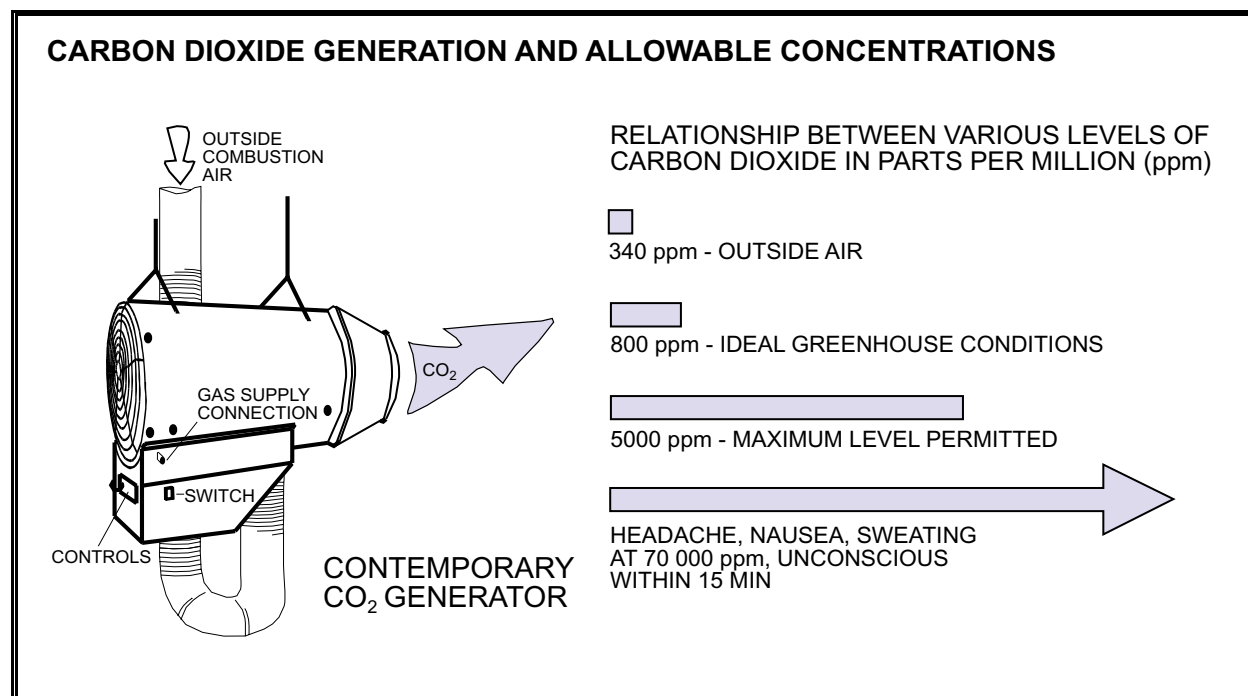
Intent and Rationale — Clause 6.3

The requirements of Clause 6.3 are intended to ensure that only carbon dioxide (CO₂) generators approved for their specific application are installed and operated so that harmful concentrations of carbon dioxide and carbon monoxide (CO) are avoided.

Virtually all CO₂ generators are manufactured by companies involved in a wide range of greenhouse and agricultural applications, and their operation often involves sophisticated controls. Manufacturers or their representatives typically start up these

appliances and verify their safe operation, since the equipment needed for verification is specialized and relatively expensive. Burners or heating appliances not specifically approved for greenhouse applications may be installed with the approval of the authority having jurisdiction.

Normally, combustion air is taken from the outdoors; however, it may be taken from the greenhouse when the rate of combustion is low in relation to the interior volume of the greenhouse. In this case, the safe levels of CO₂ and CO must be verified at initial start-up. When a CO₂ generator is used in a produce storage area, combustion air must always be taken from outside the storage area since the interior volume of air needed to prevent harmful concentrations of CO₂ and CO may be insufficient when the storage area is full of produce.



6.4 Commercial-Type Clothes Dryers

Intent and Rationale — Clause 6.4

The intent of Clause 6.4 is to ensure the fire safety of commercial-type clothes dryers, and to prevent the venting of moisture from affecting the performance of service regulators or from contaminating air entering fresh air intakes. The requirements are also intended to prevent excessive depressurization in the space occupied by the clothes dryer(s), which may lead to spillage of the products of combustion.

Commercial-type clothes dryers typically have hot exposed top surfaces that must be suitably protected in laundromat-type installations from coming in contact with combustible materials, such as clothing. Dryers and moisture exhaust ducts must also be installed with minimum clearances to combustible materials. Moisture exhaust ducts must be noncombustible, and for this reason may only be of metal construction.

Ducts may not be connected using screws since dust and lint may catch on the protruding screws and eventually plug the duct.

Moisture exhaust ducts must not terminate near service regulators since the moisture in the exhaust air stream can condense on the service regulator where it may freeze in cold weather thereby impairing the regulator's performance. Moisture exhaust ducts must also not terminate near fresh air intakes since this would cause contamination of the fresh air stream.

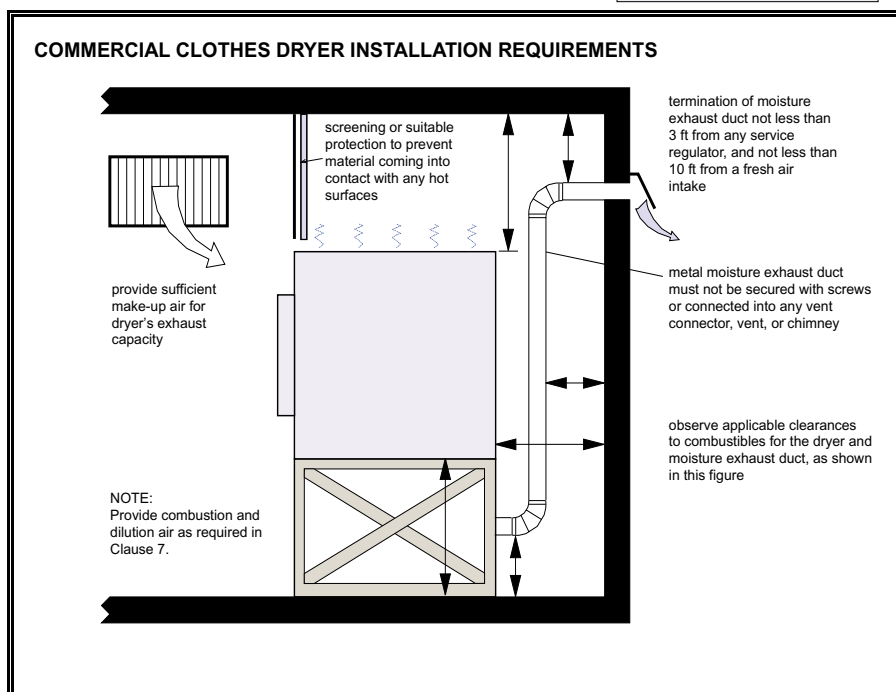
The connection of moisture exhaust ducts to vents or chimneys is prohibited since the lint blow-by may block the chimney.

Make-up air must be supplied to the area where the dryer is installed to prevent excessive depressurization and the possible spillage of other appliances, such as water heaters. Make-up air also ensures that adequate air flows are maintained for proper dryer performance.



Looking Back

Refer to the requirements of Clause 3.13.2 if reduced clearances for either the commercial clothes dryer or moisture exhaust duct are required.



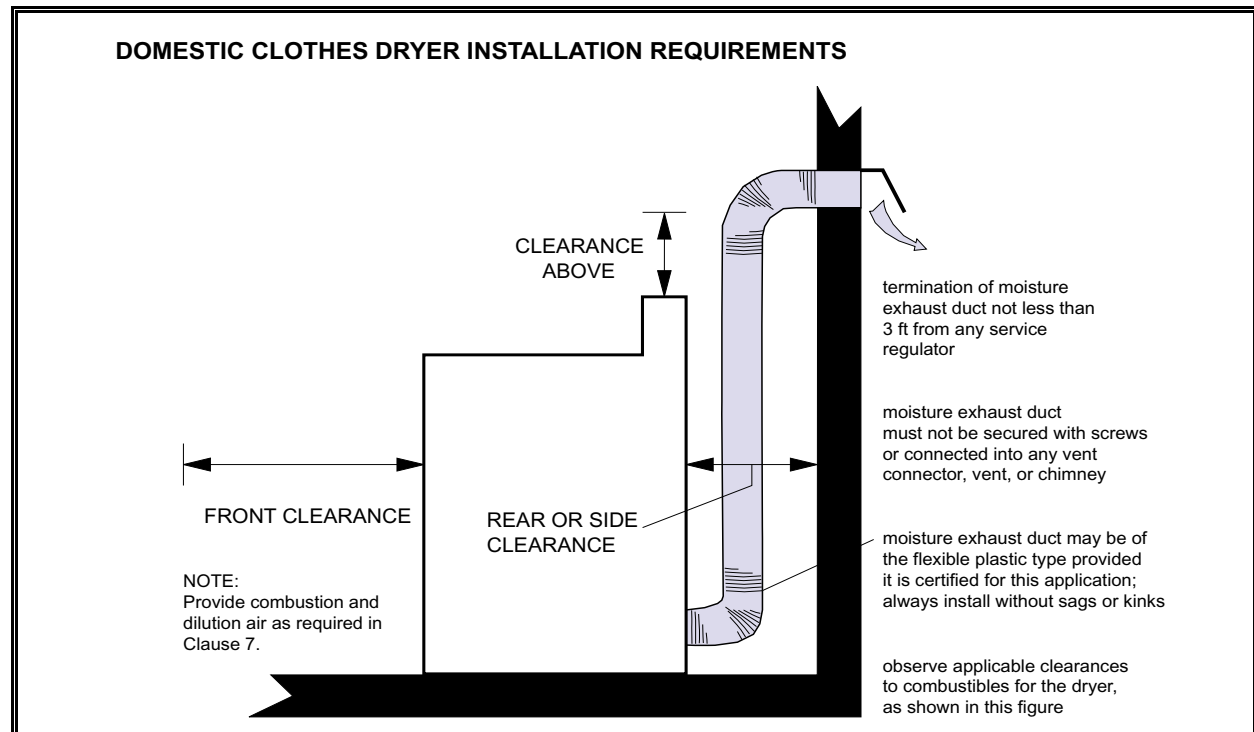
6.5 Domestic-Type Clothes Dryers

Intent and Rationale — Clause 6.5

The installation requirements for domestic-type clothes dryers are intended to ensure the use of suitable moisture exhaust ducts that are properly terminated, and the provision of safe clearances to combustible materials.

Domestic clothes dryers may use either metal exhaust ducts or flexible plastic moisture exhaust ducts, provided they are certified for

this application. Ducts may not be connected using screws since dust and lint may catch on the protruding screws and eventually plug the duct. Moisture exhaust ducts must not terminate near service regulators since the moisture in the exhaust air stream can condense and freeze on the service regulator in cold weather thereby impairing its performance. Moisture exhaust ducts must also not terminate near fresh air intakes since this would contaminate the incoming air stream.



6.6 Conversions

Intent and Rationale — Clause 6.6

The requirements of Clause 6.6 apply to appliances and are intended to ensure safe clearances to combustible materials, the good working order of the converted appliance, and the suitability of the existing chimney if it is to be used for venting the converted appliance. The minimum clearances to combustible materials for appliances converted to gas are based on testing results and acceptable past performance. Serviceability requirements apply to the safe and proper working order of the entire converted appliance. Chimneys to be used for venting converted appliances must meet the same requirements as chimneys serving typical gas appliances. Existing chimneys that have served solid or liquid fuel appliances may often fail to meet these requirements and, for this reason, their size and lining must be carefully examined by the installer.



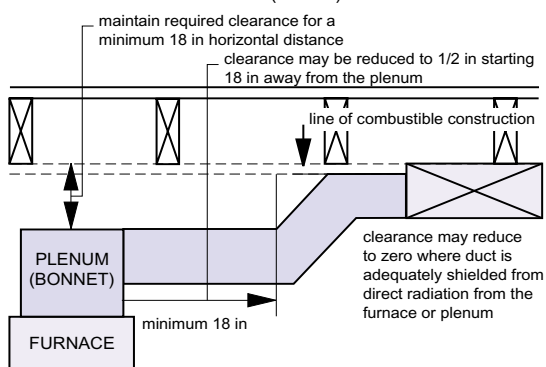
Looking Back

When considering a conversion, review the requirements in Clause 3.5 to ensure that the appliance is suitable for the intended conversion.

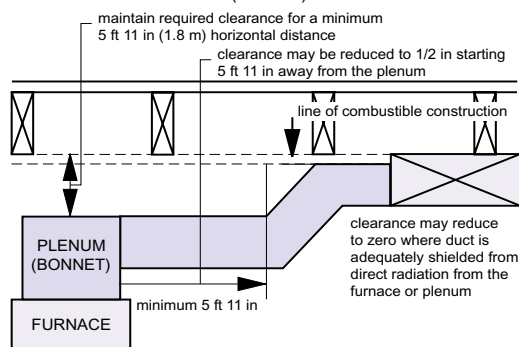
FORCED AIR FURNACE PLENUM AND DUCT CLEARANCE REQUIREMENTS

When converting a forced air furnace, ensure that required plenum and duct clearances are observed. For specific information, refer to Article 9.33.6.8 of the 1995 *National Building Code of Canada*.

PLENUM CLEARANCE 3 IN (75 mm) OR LESS



PLENUM CLEARANCE GREATER THAN 3 IN (75 mm) BUT LESS THAN 5-7/8 IN (150 mm)



6.7 Conversion Burners

Intent and Rationale — Clause 6.7

Clause 6.7 is intended to ensure the safety and compatibility of conversion burner installations.

The rationale for these requirements is conveyed and referenced within the requirements themselves.



Looking Ahead

When converting from another fuel to gas, review the requirements of Clauses 7.12.2 to 7.12.11 inclusive, to ensure that the chimney is suitable for venting the converted appliance.

6.8 Conversion of Warm Air Furnaces

Intent and Rationale — Clause 6.8

The requirements for the conversion of warm air furnaces to gas are intended to prevent the accumulation of gas in revertible flue furnaces and to ensure proper venting, condensation control in heat exchangers, and the provision of labels explaining safe operation.

Revertible flue furnaces are a common design in older oil-fired appliances. The requirements of Clauses 6.8.1 and 6.8.2 are set out to prevent pockets of gas accumulating at the bottom of the revertible flue. Clause 6.8.3 deals with the potential for condensation occurring in secondary heat exchangers that have return air passing over them. Gas appliances generally have cooler flue gas temperatures than oil-fired equipment, making the potential for condensation much higher. Clauses 6.8.4 to 6.8.6 essentially deal with basic requirements for the safety and integrity of the appliance.

6.9 Conversion of Ranges

Intent and Rationale — Clause 6.9

The intent of Clause 6.9 is to ensure that the conversion of ranges provides a level of safety and operating characteristics comparable to currently certified ranges.

When gas and propane were introduced to Canadian households, a number of these households still relied on woodstoves for cooking. Conversion to gas-type fuels became a popular, but a relatively short-lived, trend. Certified conversion equipment for this application is not commonly available today, and these requirements are now applicable only in rare cases.

6.10 Counter Appliances

Intent and Rationale — Clause 6.10

The intent of Clause 6.10 is to ensure safe clearances to combustible materials for counter appliances.

The rationale for these requirements is based on acceptable past performance.

6.11 Direct Vent Appliances

Intent and Rationale — Clause 6.11

The intent of Clause 6.11 is to ensure that direct vent appliances are installed according to the requirements of Clause 7.14.8.

The rationale for this requirement is referenced within the requirement itself.



Looking Ahead

The termination of direct vent appliances is governed by the requirements of Clause 7.14.8. Refer to this Code requirement and check any other requirements of the local authority having jurisdiction prior to the installation of a direct vent appliance.

6.12 Furnaces Used with Cooling Units

Intent and Rationale — Clause 6.12

The requirements for Clause 6.12 are intended to deal with the control of condensation resulting from the operation of connected cooling units, the isolation of air streams from heat exchangers from air streams from cooling coils when these are installed in parallel, and the compatibility of the furnace and cooling coil when installed in series.

The rationale for these requirements is conveyed within the requirements themselves.

6.13 Central Furnaces

Intent and Rationale — Clause 6.13

The intent of these Clauses is to ensure that central furnaces are adequately supported, installed with safe clearances to combustible materials, and not ducted in a manner that may depressurize the space providing the furnace with combustion air, thereby impairing combustion and/or venting performance.

Adequate support of central furnaces is required to prevent movement that may possibly induce stresses in the gas supply piping. The floor or furnace support must be of noncombustible construction for fire safety; however, this requirement may be waived where the furnace is certified for installation on a combustible floor, is installed using a manufacturer's special base, or is installed as specified in Clause 3.13.3. Clearances to combustible materials must be maintained as specified in Clause 6.13.2, and access clearances must conform with Clause 3.14.2. Return-air inlets installed in an enclosure or crawl space that provides combustion air to the furnace may depressurize the area, leading to poor combustion and possibly spillage, and, therefore, this practice is prohibited. Floor furnaces are prohibited to prevent the chance of injury to persons coming in contact with the hot grate when the appliance is operating.



Looking Back

For detailed information regarding the installation of central furnaces on combustible floors, refer to Clause 3.13.3.

6.14 Downflow Furnaces

Intent and Rationale — Clause 6.14

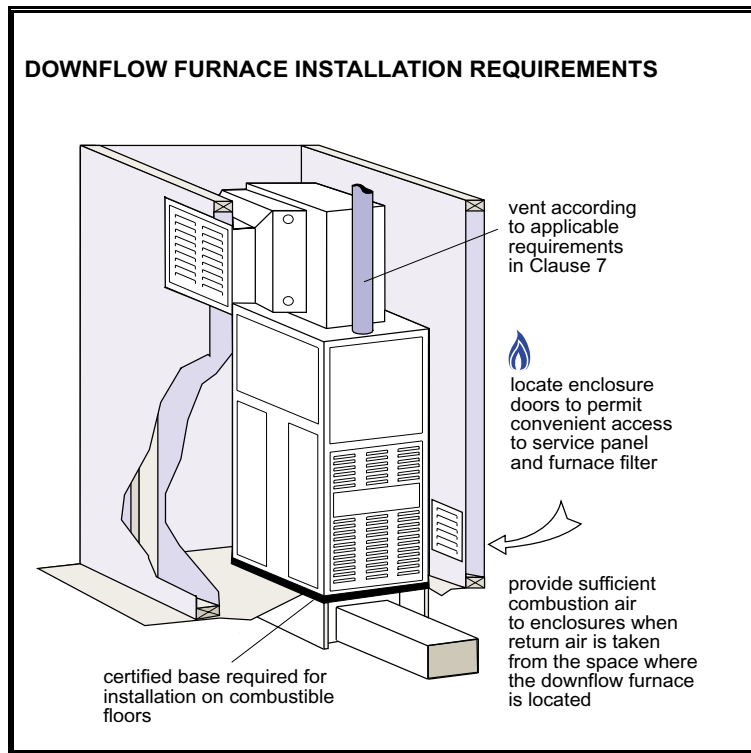
The intent of Clause 6.14 is to ensure the fire safety of downflow furnaces and to avoid the depressurization of the space providing the furnace with combustion air, which would impair combustion and/or venting performance.

Downflow furnaces approved for installation on noncombustible floors only may not be installed on or pass through a combustible floor assembly, unless they are provided with a separate base certified as a component part of the furnace. This requirement recognizes the inherent fire hazard associated with furnaces having a downward warm air discharge through a combustible floor assembly. The penetration through the floor assembly must also be sealed to serve as a gas-proof firestop in order to prevent the spread of flame or hot gases originating from the area below the penetration to the room above. Downflow furnaces located in enclosures must not take circulating and combustion air from the same space, since this competition for air supply may lead to impaired combustion and possibly depressurization of the enclosure leading to spillage.



Looking Ahead

When installing downflow furnaces that penetrate fire separations, refer to the *National Building Code* or the building code of the authority having jurisdiction to determine all applicable fire safety requirements.



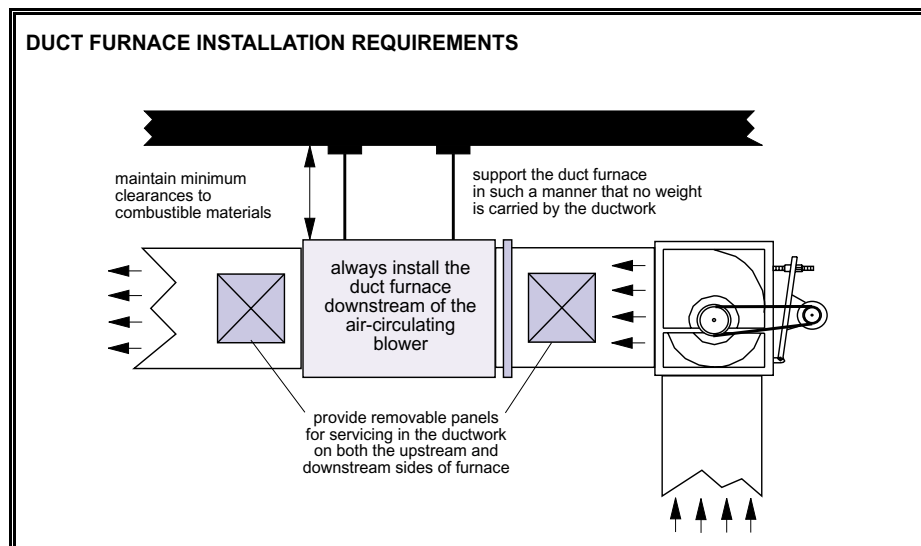
6.15 Duct Furnaces

Intent and Rationale — Clause 6.15

The requirements of Clause 6.15 are intended to ensure duct furnaces perform safely and properly, allowing adequate access for maintenance and service, without transferring any weight to the ductwork in which they are installed.

Duct furnaces may not be installed on the negative pressure (upstream) side of an air-circulating blower since this may adversely affect the combustion and venting of the furnace. Circulating air may not be taken from an enclosure containing a duct furnace for the same reason; this may cause excessive depressurization, possibly leading to spillage and the distribution of combustion products to habitable spaces. In order to permit access for maintenance and servicing, removable access panels must be provided in the ducts on both sides of the furnace. All controls must be

located on the outside of the ductwork to enable ease of operation, maintenance, and servicing. Duct furnaces must be supported in such a manner that no weight is transferred to the ductwork; the ductwork should not sag, leak, or disconnect. Minimum clearances to combustible materials are required for purposes of fire safety and are based on testing and acceptable past performance.



6.16 Horizontal Furnaces

Intent and Rationale — Clause 6.16

The intent of Clause 6.16 is to define where horizontal furnaces may be safely installed and to ensure adequate accessibility for maintenance and servicing.

Horizontal furnaces are typically installed in buildings without full basements or where floor space does not permit the installation of a central furnace. Horizontal furnaces may be suspended from a floor above a crawl space or suspended from a floor or ceiling without special approval. However, horizontal furnaces installed in an attic space must be approved for such installations and provided with a permanent walkway allowing convenient access to the control side of the furnace. For fire safety reasons, a horizontal furnace must not be installed in an attic space containing either exposed combustible insulation or wrappings for such insulation. Clearances to combustible materials required in Clause 6.16.4 are based on testing and acceptable past performance.

6.17 Wall Furnaces (Recessed Heaters)

Intent and Rationale — Clause 6.17

The requirements of Clause 6.17 are intended to ensure the fire safety of wall furnace installations.

Wall furnaces generate a concentration of heat and must be approved for installation in combustible walls to minimize the risk of fire. Removable panels, grilles, or access doors for normal servicing must not be attached to the building in order to eliminate the potential of direct transfer of heat to the building assembly. Vents concealed in partition walls must be of Type BW, in order to provide the required level of fire safety for this type of furnace installation.



Looking Ahead

When installing wall furnaces, refer to Clause 7.11 for Type BW venting requirements.

6.18 Construction Heaters and Torches

Intent and Rationale — Clause 6.18

The intent of Clause 6.18 is to ensure the safe type, location, installation, and operation of construction heaters and torches.

The rationale for these requirements is conveyed and referenced within the requirements themselves.



Looking Back

Refer to applicable piping requirements in Clause 5 when planning the installation of a construction heater being connected to temporary piping.

6.19 Direct-Fired Door Air Heaters

Intent and Rationale — Clause 6.19

The requirements of Clause 6.19 are intended to limit the application of direct-fired door air heaters and minimize the potential for products of combustion reaching harmful levels in the space occupied by a heater.

Due to the limited suitability of use for this type of heating appliance, direct-fired door air heaters may only be installed in a doorway as a barrier against cold outside air unless otherwise permitted by the authority having jurisdiction. Installation must conform with the basic safety requirements for direct-fired make-up air heaters due to the similar nature of these appliances. In order to minimize the entry of combustion products into the building, the operation of the heater must be interlocked in a manner regulated by the operation and opening (aperture) of the door. In addition, heated air and the products of combustion must be directed outdoors.



Looking Ahead

When installing construction heaters in enclosures, refer to the requirements of Clause 7.2.4 for the provision of outdoor air.

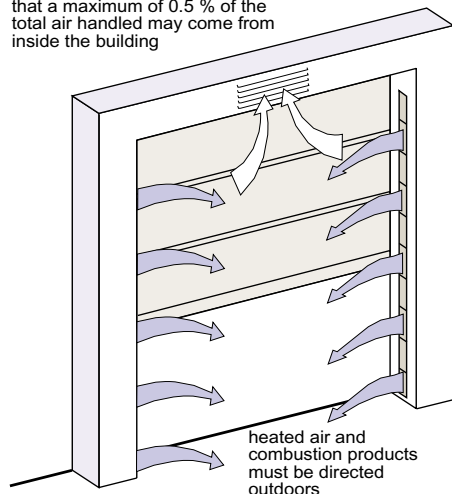


Looking Ahead

The installation of direct-fired door air heaters are also governed by the requirements of Clauses 6.20.7 through 6.20.11 inclusive. Review the applicable requirements in Clause 6.20 prior to proceeding with the installation any direct-fired door air heaters.

DIRECT-FIRED DOOR HEATER INSTALLATION REQUIREMENTS

all air supply to the door heater must be provided from the outside, except that a maximum of 0.5 % of the total air handled may come from inside the building



the direct-fired door air heater must be interlocked with the door it serves so that the heater can operate only when EITHER the door is 80% open OR the door is at least 15% open and an interlocked timed relay proves the door is open 80% within 60 seconds



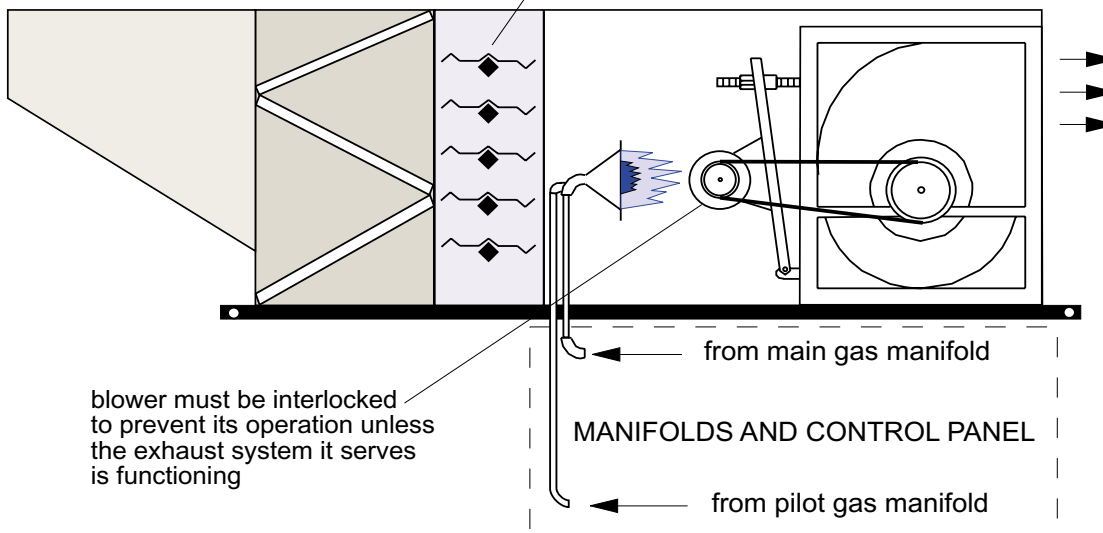
review requirements in Clauses 6.20.7 through 6.20.11 inclusive for applicable door heater requirements

DIRECT-FIRED MAKE-UP AIR HEATER INSTALLATION REQUIREMENTS



locate DFMAH for ease of access and to minimize noise transmission to the outdoors

automatic louvres must be interlocked to ensure maximum designed opening prior to the start-up of the DFMAH



blower must be interlocked to prevent its operation unless the exhaust system it serves is functioning

from main gas manifold

MANIFOLDS AND CONTROL PANEL

from pilot gas manifold

6.20 Direct-Fired Make-Up Air Heaters (DFMAH)

Intent and Rationale — Clauses 6.20.1 to 6.20.8

Clauses 6.20.1 to 6.20.8 are intended to address the suitability of use, operation, and performance, and the control of combustion product exposure for direct-fired make-up air heaters (DFMAH).

A DFMAH is generally not intended as a space-heating appliance. DFMAH appliances may only be used when it is necessary to exhaust inside air and replace it with preheated outside air; however, additional applications, such as in mine shafts, elevator shafts, stairwells, and storage garages, are permitted provided applicable installation requirements are satisfied.

Risks associated with prolonged exposure to products of combustion preclude the supply of make-up air using a DFMAH to an area where sleeping accommodation is provided. For reasons of combustion product contamination and proper operation, the air discharge capacity of a DFMAH may not exceed the total discharge capacity of the exhaust system by more than 10%, and the DFMAH must be interlocked in a manner to prevent its operation unless the exhaust system is functioning. When the exhaust system, in the absence of make-up air supplied by the DFMAH, may affect the satisfactory venting of other gas appliances, it must be interlocked in such a manner that it will only function when the DFMAH blower is operating. All air handled by a DFMAH must be brought directly from outdoors; however, a minimal quantity of primary combustion air may be taken from inside the building since the use of warmer primary combustion air to improve combustion efficiency may be desirable.

To ensure safe and proper operation, automatically operated louvres for inlet and/or discharge air must be interlocked to ensure their maximum designed opening prior to the start-up of the DFMAH.

The total air replacement to a spray booth must not exceed the total exhaust capacity of the booth so that it will function in a depressurized mode as intended.

Mine shafts served by a DFMAH do not require an interlocked exhaust system if an exhaust opening of sufficient free cross-sectional area is provided. In this case, the configuration of the shaft and opening must not impair the combustion and air handling performance of the DFMAH.

Intent and Rationale — Clauses 6.20.9 to 6.20.11

Clauses 6.20.9 to 6.20.11 are intended to maintain the fire safety of DFMAH installations.

Due to the exposed flame in a DFMAH, it may not be located near a combustible concentration of gas, vapour, or dust. The minimum 20 ft separation required is based on generic past performance. Supply or discharge ducting in which accumulations of combustible gas or combustion products could be trapped must not be connected to a DFMAH. Clearances to combustible materials, as specified on the appliance rating plate, must be maintained to minimize the risk of fire.

Intent and Rationale — Clauses 6.20.12 and 6.20.13

Clauses 6.20.12 and 6.20.13 are intended to ensure that DFMAH appliances in elevator shafts, stairwells, and storage garages are interlocked with specified sensor devices in a manner that permits the operation of the DFMAH to be tested.

In order to prevent prolonged exposure to products of combustion from a DFMAH used to ventilate or pressurize an elevator shaft or stairwell, its operation may only be engaged by a fire alarm activated under normal operation.

A DFMAH used for this purpose must be capable of being tested using a normally open momentary manual switch, without activation of the fire alarm. A DFMAH solely actuated by a carbon monoxide sensor and used to ventilate a storage garage must be capable of being tested in a similar manner. In both cases, the switch must be located on or near the DFMAH so that it may be conveniently tested and the function of the switch must be clearly identified.

Kitchens interconnected to a public area by permanent openings with a free area exceeding 16 ft² must be operated under a balanced or mildly depressurized pressure regime to control cross-contamination. The limits of imbalance permitted reflect the requirements for proper DFMAH performance and recognize the potential impacts of excessive air pressure imbalances on the performance of an HVAC system serving the public area.

6.20.14 When a **DFMAH** is either installed in or ducted to a kitchen, it shall be installed in accordance with the following procedure:

- (a) Where the food preparation area and the area frequented by the public is interconnected by means
 - (i) of either normally closed doors or a permanent opening or openings and the total free area of the opening or openings does not exceed 16 ft² (1.5 m²), the **DFMAH** shall be interlocked with a mechanical exhaust system and proven air flow capacity of the interlocked exhaust system shall not be less than 90% of the make-up **air supply**; or
 - (ii) other than indicated in (i), the **DFMAH** shall be interlocked with a mechanical exhaust system and the proven air flow capacity of the interlocked exhaust system shall in no case be less than 100% or more than 105% of the make-up **air supply**.
- (b) All other requirements contained in Clause 6.20, where applicable, shall apply.

Intent and Rationale — Clause 6.20.14

The intent of Clause 6.20.14 is to limit the exchange of air between a food preparation area and an area frequented by the public in facilities where the kitchen is served by a DFMAH. Where a kitchen is practically closed off from the area frequented by the public, it may be mildly pressurized by the DFMAH without causing a noticeable transfer of air from the food preparation area to the public area.

6.21 Infra-Red Heaters

6.21.1 Where an **infra-red heater** is of the unvented type, it shall

- (a) be protected against physical damage;
- (b) comply with Clause 3.9.2;
- (c) not be installed in a residential or **care or detention occupancy building**;
- Δ (d) when **certified** for use as a construction heater, comply with Clause 6.18 and be exempted from Items (e), (f), and (g) of this Clause;
- (e) be provided with mechanical **ventilation** so located that the **products of combustion** from each **heater** are effectively removed outdoors, have a **ventilation** volume of at least 300 cfm for each 100 000 Btuh (30 kW) input or fraction thereof, and the mechanical **ventilation** is sufficient to maintain the level of carbon dioxide (CO₂) at less than 5000 ppm measured 6 ft (2 m) above the work area;
- (f) have the **ventilation** system so interlocked that any reduction of the volume of air flow required by Item (e) for a **heater** or group of **heaters** will cause the shutdown of that **heater** or group of **heaters**;
- (g) be provided with combustion and **ventilation air** compatible with Item (e);
- (h) not be installed in an exit passageway or stairway or within 8 ft (2.5 m) measured horizontally from an exit door; and
- (i) be provided with clearance to **combustible** material as **certified** and indicated on the **appliance**.

Intent and Rationale — Clause 6.21.1

The intent of this clause is to restrict the application of unvented infra-red heaters, to ensure that their products of combustion do not exceed acceptable concentrations in the area they serve, to minimize the risk of their causing a fire, and in the event they do, to ensure that they are located in a manner that does not impede safe exiting from the building.

Unvented infra-red heaters, due to the nature of their construction and operation, must be protected against physical damage and must not be installed in a hazardous location for safety reasons. Due to the absence of venting, prolonged exposure to products of combustion must be avoided and, for this reason, unvented infra-red heaters cannot be installed in a residential or institutional building.

In permitted applications, sufficient mechanical ventilation must be provided to maintain acceptable levels of carbon dioxide in work areas, and the ventilation system and heater(s) it serves must be interlocked so that a reduction in ventilation air flow below the required capacity will automatically shut down the heater(s). Clearances to combustible materials as certified and indicated on the unvented infra-red heater must be maintained to ensure fire safety, and the appliance may not be installed in such a way that, if it became a cause or source of fire, it could prevent persons from safely exiting the building.

- Δ **6.21.2** Where it is not possible to interlock heaters due to the use of portable *infra-red heaters*, the ventilation system described in Clause 6.21.1(e) shall be connected to a CO₂ monitor with an audible and visual alarm.

Intent and Rationale — Clause 6.21.2

The intent of this clause is to ensure that occupants are warned of potentially dangerous concentrations of carbon dioxide (CO₂) resulting from the operation of infra-red heaters.

Portable infra-red heaters cannot be practically interlocked with the ventilation system, hence an audible and visual CO₂ alarm affords occupants a comparable level of safety.

- Δ **6.21.4** When an *infra-red heater* is installed in an area of a *garage* or a car wash where vehicles may be exposed to radiant heat, it shall
- (a) comply with Clause 6.21.1 if of the unvented type; or
 - (b) comply with Clause 6.21.3 if of the vented type.

The minimum clearance from the radiant face of the *infra-red heater* to the upper surface of the highest vehicle shall not be less than the *certified* clearance to *combustible* material as indicated on the *appliance*. Provision shall be made to maintain these minimum specified clearances by either an interlock to shut-off the gas supply until the required clearances have been re-established or a protective bar or other device that warns of the clearances not being maintained.

**Looking Back**

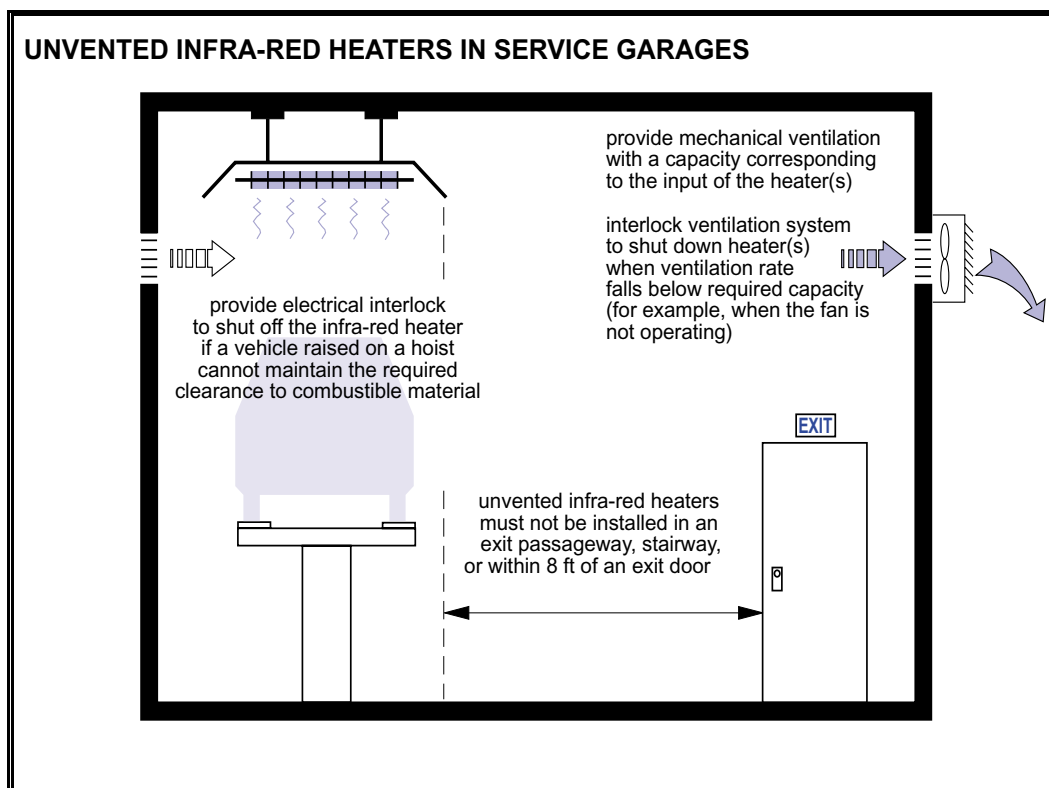
Refer to Clause 3.9.2 for requirements pertaining to the installation of an infra-red heater in a hazardous location.

Intent and Rationale — Clauses 6.21.3 to 6.21.6

Clauses 6.21.3 to 6.21.6 are intended to provide fire safety requirements common to all types of infra-red heaters.

Infra-red heaters are commonly installed in garages, car washes, airplane hangars, and service spaces where radiant heating is capable of compensating for uncomfortable exposure due to drafts. In addition to complying with the requirements specific to the type of infra-red heater being installed, clearance to combustible material must be carefully determined based on

the minimum distance between the face of the infra-red heater and the upper surface of the highest vehicle that is located in the space served by the heater. When minimum clearances cannot be maintained for vehicles raised on hoists, an electrical interlock must be provided to shut off the infra-red heater's burner and prevent its operation until the required clearance has been re-established. For safety reasons, infra-red heaters installed in airplane hangars must be protected from physical damage by moving aircraft, cranes, and scaffolding and located a minimum of 8 ft above the floor to reduce the potential for damage from surface vehicles.



6.22 Room Heaters

Intent and Rationale — Clause 6.22

The intent of Clause 6.22 is to provide requirements for the fire safety and proper venting of room heaters.

Room heaters may be vented or unvented, and of the circulating or radiant type. Prior to obtaining and installing an unvented room heater (an appliance that vents the products of combustion directly into the room), contact the authority having jurisdiction for a ruling.

In bathrooms, only direct vent-type room heaters may be installed, since these rooms are often small and provide inadequate air supply for combustion and venting, a situation that can lead to carbon monoxide poisoning or asphyxiation.

Room heaters approved for use in noncombustible fireplaces must be installed according to the manufacturer's certified installation instructions. This requirement reflects the means by which these heaters have been designed, tested, and approved. All radiant type room heaters must be vented using either a vent or a chimney, and where they are installed in a fireplace having a manual damper, a permanent stop must be provided on the

damper to prevent its complete closure. A closed damper would lead to the spillage of the products of combustion directly into the room. Room heaters installed in rooms providing sleeping accommodation or in public areas must have an automatic temperature control to prevent overheating, a pressure regulator and shut-off control to ensure safety, and be vented to minimize spillage. Room heaters must be located to avoid fire hazards and enable the free movement of people. For free-standing room heaters, minimum clearances to combustible materials are not differentiated based on the type of heater, either circulating or radiant. This implies that requirements for radiant-type room heaters apply equally to circulating-type room heaters.

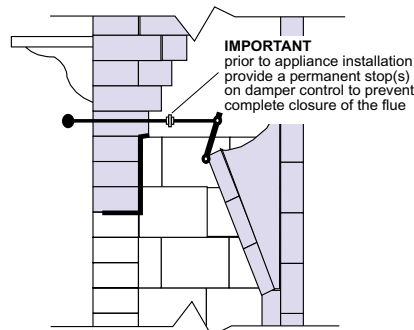


Better Practice

Clause 6.22.4 does not specify the free area required to be maintained by the permanent stop(s). Refer to the free area required under Clause 7.13 for proper venting, based on the room heater input.

This caution may also be applied to the requirements of Clause 6.23.5.

IMPORTANT RADIANT-TYPE ROOM HEATER AND GAS LOG INSTALLATION REQUIREMENT



6.23 Decorative Appliances and Gas Logs

Intent and Rationale — Clause 6.23

The requirements of Clause 6.23 are intended to address the operating safety and venting of decorative appliances and gas logs.

Decorative appliances approved for use in noncombustible fireplaces may only be installed in fireplaces conforming to the requirements of the building code of the authority having jurisdiction or, in its absence, the *National Building Code of Canada*. This requirement reflects the means by which these appliances have been designed, tested, and approved. All decorative appliances must be vented to either a vent or a chimney.

Decorative appliances, due to their spillage susceptibility, may not be installed in bathrooms or rooms providing sleeping accommodation unless they are of the direct vent type or certified for installation in a bedroom or bed-sitting room. Gas logs may only be installed in fireplaces and must be certified for this application. In addition, the chimney damper must be permanently secured in an open position to effectively vent the appliance.

6.24 Swimming Pool Heaters

Intent and Rationale — Clause 6.24

The intent of Clause 6.24 is to require the proper location, installation, and maintenance of swimming pool heaters.

The rationale for these requirements is conveyed within the requirements themselves, except for Clause 6.24.7.



Looking Back

For outdoor swimming pool heater installations, refer to the requirements of Clause 3.15 in this handbook.



Looking Ahead

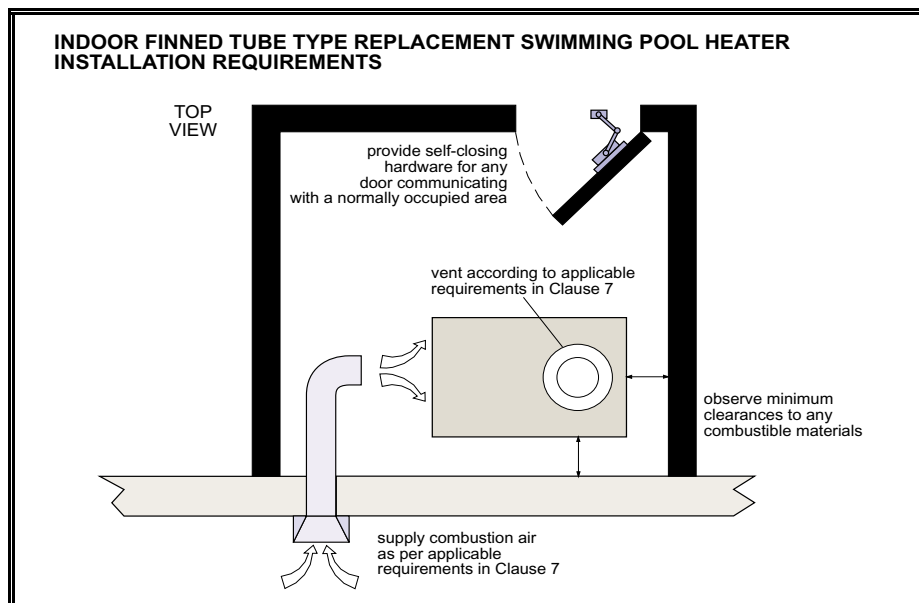
Refer to the requirements for air supply in Clause 7 of this handbook to determine the applicable combustion air requirements for indoor swimming pool heater installations approved under Clause 6.24.7.

- 6.24.7** With prior approval of the **authority having jurisdiction**, when an existing indoor swimming pool heater is being replaced with a gas-fired swimming pool heater of the finned tube type and it is neither possible nor practicable to comply with Clause 6.24.6, a gas-fired swimming pool heater of the finned tube type may be installed indoors in the same location as the **heater** that is being replaced, provided that
- (a) there is compliance with Clauses 6.24.1 and 6.24.2;
 - (b) any door directly communicating with an area that is normally occupied is equipped with self-closing hardware; and
 - (c) **combustion air** is supplied from the outdoors to the space in which the **heater** is located in accordance with Clauses 7.2.4 and 7.3 or, if applicable, with Clause 7.4.

Intent and Rationale — Clause 6.24.7

The intent of Clause 6.24.7 is to permit the installation of finned tube type swimming pool heaters as replacements for heaters located indoors, where outdoor installation due to the configuration of existing piping is not practical.

In many cases, electric resistance swimming pool heaters are replaced with a gas-fired appliance. Typically, the original unit is located indoors, and the piping is buried beneath a concrete deck or apron surrounding the pool, making its relocation prohibitively expensive. With the prior approval of the authority having jurisdiction, a finned tube type swimming pool heater may be installed inside as a replacement provided it is properly supported and installed with minimum clearances to combustible materials. In addition, any door directly communicating with an occupied area must be equipped with self-closing hardware to ensure the isolation of the space housing the heater. Combustion air must also be supplied to the space in which the heater is located to ensure safe and proper performance. These requirements reflect the experience of the authority having jurisdiction and recognize the need to uncouple the heater's operation from the influence of building pressures.



6.25 Water Heaters

Intent and Rationale — Clause 6.25

Clause 6.25 is intended to limit the location of water heaters depending on how they are vented, to provide suitable temperature and pressure relief, and to ensure fire safety, appropriate access, and, in the case of instantaneous type (tankless) water heaters, sufficient water supply for proper operation.

Water heaters must not be installed in bathrooms or rooms providing sleeping accommodation unless they are of the direct vent type. This requirement addresses the spillage susceptibility of nondirect vent appliances, and the potential hazards associated with spillage and prolonged exposure to products of combustion.

An approved temperature and pressure relief device, complete with a discharge pipe, is required to relieve an over-pressure or elevated temperature condition that may result in damage to the tank and/or water piping. The discharge pipe must terminate in such a manner that the discharge of water minimizes the risk of damage or personal injury.

Due to the access requirements associated with maintenance and servicing, direct vent water heaters must have a minimum clearance of 3 ft on the burner side. Clearances to combustible material for the purpose of fire safety are based on generic past performance. Instantaneous-type (tankless) water heaters installed on a combustible wall must be provided with suitable protection extending the full length and width of the heater and its draft hood. This requirement recognizes that, unlike tank-type water heaters, the burner flame is not surrounded by water in a tank, but is exposed to the air space surrounding the heat exchanger. Another requirement specific to instantaneous-type water heaters is that the installer must ensure that a sufficient rate of water supply is available for proper operation of the heater prior to installation. Overheating of the heat exchanger leading to damage or reduced durability may occur when the rate of water supply is insufficient.

6.26 Unit Heaters

Intent and Rationale — Clause 6.26

The requirements for unit heaters are intended to ensure the fire durability of supports and the safe venting of the appliance, and to provide adequate protection against physical damage and adequate clearances for the purpose of fire safety.

Unit heaters that are suspended must be securely supported to avoid the transfer of weight to gas supply piping, and the supports must be fabricated from metal to ensure that they can withstand normal operating heat exposure and are durable in the event of fire. Unit heaters must not be installed in rooms susceptible to negative pressures or in such a manner to induce negative pressures in rooms where they are installed. This requirement relates to the risk of spillage associated with the operation of a unit heater in a depressurized space. Unit heaters in garages, in order to be adequately protected from vehicle impacts, must be installed with a minimum clearance of 8 ft above the floor. This clearance may be reduced to 4 ft when suitable protection against physical damage, approved by the authority having jurisdiction, is provided. Installation with less than 4 ft of clearance between the unit heater and the floor in garages is prohibited due to the risk of igniting combustible vapours. Minimum clearances between the unit heater and combustible materials are based on testing and acceptable past performance.



Looking Back

Clause 3.16 in this handbook contains the general requirements for appliances installed in garages. Clause 3.23 deals with requirements for the protection of appliances from physical damage. Review these requirements prior to proceeding with any unit heater installation.

6.27 Hotplates

Intent and Rationale — Clause 6.27

Clause 6.27 is intended to provide for the safe operation of installed hotplates.

Hotplates must be securely mounted and connected with rigid gas piping. Movement may cause stress on piping, dangerously reduce clearances to combustible materials, and possibly lead to instability causing the spillage of heated cookware contents. Hotplates are unvented appliances and for this reason may not be installed in bedrooms due to the risks of prolonged exposure to products of combustion. Hotplates may be installed in bed-sitting rooms if such rooms are provided with another approved means of space heating. This requirement recognizes that the hotplate may otherwise be used for space heating, leading to possible overexposure to products of combustion. Minimum clearances to combustible materials are based on acceptable past performance. It should be noted that a large number of alternative appliances, such as microwave and convection ovens, have virtually eliminated the installation of hotplates in bed-sitting rooms.

6.28 Incinerators

Intent and Rationale — Clause 6.28

Clause 6.28 is intended to provide requirements for the fire safety and effective venting of incinerators.

Incinerators should be installed as close as practicable to a chimney to provide enhanced fire safety and venting performance. For this reason, wall-type incinerators must be installed in a noncombustible wall with an integral chimney flue. Vent connectors must be directly connected to a chimney using a separate thimble and the thimble must conform to the requirements of Clause 7.18.12 when the vent passes through a combustible wall or partition. Minimum clearances between the incinerator and combustible materials are based on

acceptable past performance. Note that with growing concern for the environment and air quality, incinerators are prohibited in many jurisdictions



Looking Ahead

When an incinerator vent connector passes through a wall or partition of combustible material, it shall be guarded at the point of passage as specified in Clause 7.18.12.

6.29 Lighting

Intent and Rationale — Clause 6.29

The intent of Clause 6.29 is to ensure the proper support of pendant type gas lighting fixtures and the maintenance of safe clearances to combustible materials.

The rationale for these requirements is conveyed within the requirements themselves.

6.30 Commercial Cooking Appliances

Intent and Rationale — Clause 6.30

Clauses 6.30.1 to 6.30.4 are intended to ensure the operating and fire safety of commercial cooking appliances.

Commercial cooking appliances must be installed level on a firm support to ensure that cookware remains stable under normal impacts and vibration associated with cooking activities. Minimum clearances to combustible materials based on generic past performance must be maintained. For side and rear clearances, a fixed, noncombustible means, such as a metal bracket or spacer, must be provided to ensure that the minimum clearance is maintained. Combustible material located within 18 in horizontally of a cooking top section must be protected for a vertical distance of 36 in above the surface of the cooking top. This requirement recognizes the higher likelihood of grease fires involving commercial cooking equipment. Adequate clearance, either in the form of horizontal spacing or a vertical barrier, must also be provided between a deep fat fryer and an open flame of an adjacent appliance to minimize the risk of a grease fire.



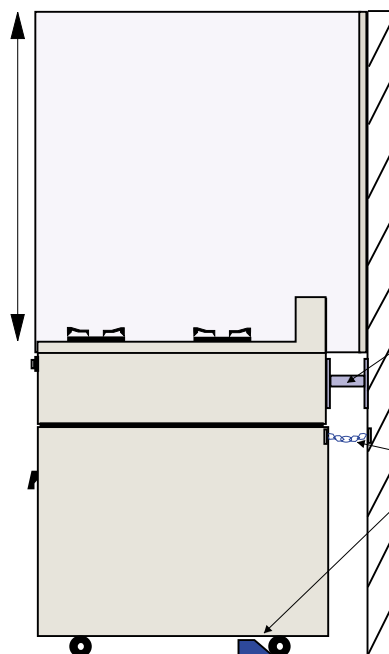
Looking Back

When installing commercial cooking appliances having wheels or rollers, Clause 5.22.5 requires that a restraining device, acceptable to the authority having jurisdiction, must be provided.

COMMERCIAL COOKING APPLIANCE INSTALLATION REQUIREMENTS

any portion of combustible material located within 18 in horizontally from a cooking top section must be protected for a vertical distance of 36 in

NOTE:
Movable commercial cooking appliances must be connected by a certified connector for this application. See Clause 5.21.4.

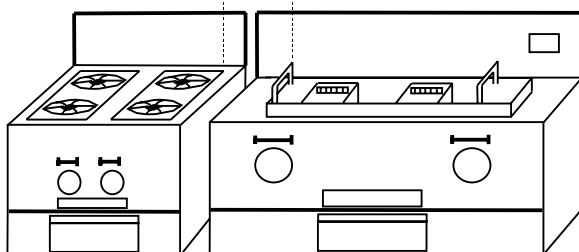


a noncombustible, fixed means for maintaining a minimum 6 in clearance between combustible materials and the sides and rear of the appliance must be provided

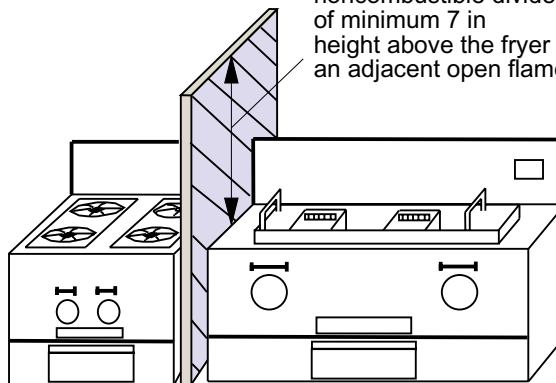
when a metal connector is used on a commercial appliance installed on wheels or rollers, a restraining device acceptable to the authority having jurisdiction must be provided. (See Clause 5.21.5.)

REQUIRED SEPARATION BETWEEN DEEP FAT FRYERS AND OPEN FLAME APPLIANCES

a minimum clearance of 16 in must be provided between a deep fat fryer and an open flame of an adjacent appliance



alternatively, provide a noncombustible divider of minimum 7 in height above the fryer and an adjacent open flame



6.31 Residential-Type Ranges

Intent and Rationale — Clause 6.31

The requirements of Clause 6.31 are intended to prescribe the safe location and proper installation of residential-type ranges.

The rationale for these requirements is conveyed and referenced within the requirements themselves, except for Clauses 6.31.6 and 6.31.7.

Intent and Rationale — Clauses 6.31.6 and 6.31.7

The intent of Clauses 6.31.6 and 6.31.7 is to ensure adequate fire safety while providing sufficient flexibility for the installation of a cupboard or similar combustible cabinetry over the range.

Residential-type ranges are tested to determine the certified clearances to combustible materials specified on the appliance rating plate. Installations must not contravene these clearance requirements; however, there are instances when the Code minimum clearance above the range of 30 in is too high to accommodate cabinetry that is existing or preferred. This clearance may be reduced to 24 in if the specified protection is provided.

Intent and Rationale — Clause 6.32.2

The requirements of Clause 6.32.2 are intended to ensure the safety of building occupants against potential exposure to carbon monoxide when an unvented refrigerator is installed within a dwelling.

An acceptable level of safety against carbon monoxide exposure is provided when an unvented gas refrigerator is certified with an approved carbon monoxide detector interlocked with the shut-off for the gas supply to the burner.

This new Code requirement, which permits the installation of certified gas refrigerators in dwellings, must be carefully applied in practice. Recent developments in carbon monoxide detectors and interlocking controls have been integrated to ensure that in the event of a venting failure, the gas supply to the refrigerator burner will be shut off. Installers must carefully check that the gas refrigerator is properly certified to applicable standards, and correctly installed according to manufacturer's certified installation instructions. Regulatory authorities are encouraged to provide convenient, updated information on certified gas refrigerators that are permitted for installation in dwellings within their jurisdiction.

6.32 Refrigerators

6.32.1 Except when permitted by Clause 3.13.2, a refrigerator shall have the following minimum clearances to **combustible** material, disregarding any guard or **baffle** on the refrigerator: above, 12 in (300 mm); back and sides, 2 in (50 mm).

- Δ **6.32.2** An unvented refrigerator may be installed in a **dwelling unit** if certified with a carbon monoxide detector interlocked to shut off the gas supply to the burner when exposed to carbon monoxide levels not exceeding those specified in the CGA Standard CAN/CGA-6.19.

6.33 Stationary Gas Engines

6.33.1 Supply piping to a gas engine shall be sized according to both the maximum rate of gas consumption and the requirements of Clause 5. When more precise information regarding the maximum rate of gas consumption is not available from the manufacturer, the size of piping shall be computed for normal operation to provide 10 000 Btuh (3 kW) per brake horsepower for 4-cycle engines and 13 000 Btuh (4 kW) per brake horsepower for 2-cycle engines. When either overloads or high starting loads are likely to be encountered, the size of piping shall be computed on a basis proportional to the increased input required.

6.33.2 A gas engine shall be equipped with

- (a) an automatic *safety shut-off valve*;
- (b) an automatic speed governor;
- (c) a vacuum switch or low oil pressure switch;
- (d) a *zero governor*-type *regulator*; and
- (e) a flexible *hose connector*, which shall be of the *approved* heavy-duty type where the *connector* is installed on the upstream side of the *zero governor*-type *regulator*.

Intent and Rationale — Clauses 6.33.1 and 6.33.2

The intent of these Clauses is to ensure adequate sizing of gas supply to stationary gas engines and to provide essential operating safety and engine protection features.

Stationary gas engines are generally used for standby or alternate electrical power supply, or as co-generation equipment. An adequate supply of gas is therefore required for proper and reliable performance. For operating safety reasons, an automatic safety shut-off valve is required to prevent the accumulation of gas when the engine is not firing. In addition, a zero governor-type regulator is required to maintain the gas supply at atmospheric pressure, and any connection upstream of this regulator must be an approved flexible hose connector of the heavy duty type to minimize the risk of leaking gas at higher than atmospheric pressure. In order to protect the engine from damage, an automatic speed governor and a vacuum switch or low oil pressure switch must also be installed.

6.33.3 Where the input to an engine is in excess of 1 000 000 Btuh (300 kW), an additional automatic *safety shut-off valve* shall be provided and shall be piped in series and wired in parallel with the *automatic safety shut-off valve* required under Clause 6.33.2.

Intent and Rationale — Clause 6.33.3

The intent of Clause 6.33.3 is to provide an additional measure of operating safety for engines with an input in excess of 1 000 000 Btuh (300 kW).

Engines with an input in excess of 1 000 000 Btuh (300 kW) handle gas supply volumes potentially capable of creating dangerous explosion and fire hazards; hence, two safety shut-off valves are required in the event that one of the valves malfunctions.

6.33.4 Engine exhaust gases shall be piped either

- (a) by the most direct route to an outdoor location where they can neither be trapped nor drawn into a *building* through a window, door, or other opening; or
- (b) to a *chimney* conforming to Clause 6.33.9(b).

6.33.5 For the purpose of determining exhaust piping requirements for gas engines, the exhaust discharge temperature shall be considered 1000 °F (550 °C) normally and 1400 °F (760 °C) for infrequent brief periods.

6.33.6 An exhaust pipe passing directly through a *combustible* roof shall be guarded at the point of passage by a ventilated metal thimble that extends not less than 9 in (225 mm) above and 9 in (225 mm) below the roof construction and that is 12 in (300 mm) larger in diameter than the pipe. If a double *ventilation* metal thimble is used, the same requirements shall apply, except that the thimble shall be at least 6 in (150 mm) larger in diameter than the pipe.

6.33.7 An exhaust pipe passing directly through a *combustible* wall or partition shall be guarded at the point of passage by either

- (a) a metal ventilated thimble not less than 12 in (300 mm) larger in diameter than the exhaust pipe; or
- (b) a metal or burned fire clay thimble built into brickwork or other *noncombustible* material providing not less than 8 in (200 mm) of insulation between the thimble and the *combustible* material.

6.33.8 An engine exhaust pipe shall not be installed in a floor, ceiling, attic, or concealed space, but may pass through such spaces, provided that it is installed inside either a *masonry chimney* or a *factory-built chimney* of appropriate temperature rating and provided that the *chimney* does not serve any other type of *appliance*.

6.33.9 An engine exhaust pipe shall not discharge into

- (a) a gas *vent*;
- (b) a *chimney* having a temperature rating less than the maximum temperature of the exhaust gas; and
- (c) a *chimney* that serves another *appliance*.

6.33.10 A room containing a stationary gas engine shall have

- (a) a *combustion air* opening(s) sized in accordance with Clause 7.4.3; and
- (b) *ventilation* openings equal in size to at least 10% of the size of the opening(s) determined in Item (a), but in no case less than 10 in² (6500 mm²).

This requirement shall apply to engines of all inputs.

Intent and Rationale — Clauses 6.33.4 to 6.33.10

The requirements of Clauses 6.33.4 to 6.33.10 are intended to address the proper exhausting of stationary gas engines, including the provision of combustion and ventilation air to enclosures housing engines, and also the maintenance of the durability and fire safety of exhaust piping.

Stationary gas engine exhaust must be exhausted in a manner that does not pose a fire risk to prevent the contamination of indoor air. For this reason, the connection, passage, and termination of exhaust piping must comply with applicable requirements. Exhaust piping must also be capable of withstanding exhaust temperatures. Rooms housing stationary gas engines must be provided with sufficient combustion air for the demands of the engine and adequately ventilated to avoid overheating or the accumulation of hazardous concentrations of gas.



Looking Ahead

Refer to Clause 7.4.3 when sizing combustion and ventilation air openings for stationary gas engines located in rooms or enclosures.

6.33.11 Where an engine is of an automatic start type, it shall be equipped with overcrank protection in addition to the requirements of Clauses 6.33.2 and 6.33.3.

Intent and Rationale — Clause 6.33.11

Clause 6.33.11 is intended to protect automatic start-type engines from overcranking when ignition is not initiated within a reasonable period of time.

In the event that ignition of an automatic start-type stationary gas engine does not occur, the starting cycle must be interrupted. Otherwise, a potentially explosive quantity of gas may accumulate within the exhaust manifold of the engine.

6.33.12 Where the gas supply pressure is in excess of 0.5 psig (3.5 kPa), a *pressure regulator* of the lock-up type shall be provided to the entrance to the *valve train*.

6.33.13 Where all *components* on the *valve train* are not pressure-rated for the inlet supply pressure, a pressure relief *valve* shall be provided immediately downstream of the *pressure regulator* required under Clause 6.33.12 and shall be set to prevent pressure build-up exceeding that of the lowest rated downstream *component*.

Intent and Rationale — Clauses 6.33.12 and 6.33.13

Clauses 6.33.12 and 6.33.13 are intended to provide the safe regulation of gas supply pressure for stationary gas engines.

Where the gas supply pressure is in excess of 0.5 psig (3.5 kPa), a tamper-proof pressure regulator must be provided for safety reasons. A pressure relief valve must also be provided immediately downstream of this pressure regulator when all of the components on the valve train are not pressure-rated for the inlet supply pressure. The pressure relief valve must be set to the lowest pressure rating of any downstream components to avoid leakage or rupture of such components.

6.33.14 Each gas engine shall be provided with a clearly legible, permanent rating plate indicating

- (a) the manufacturer's or vendor's name;
- (b) the fuel to be supplied to the engine;
- (c) the electrical rating;
- (d) the maximum input rating; and
- (e) the inlet pressure at the point of connection to the supply piping.

Intent and Rationale — Clause 6.33.14

Clause 6.33.14 is intended to provide essential information for the installation, inspection, maintenance, and servicing of stationary gas engines.

The rating plate labelling requirements set out in Clause 6.33.14 represent the essential information required for the installation, inspection, maintenance, and servicing of stationary gas engines.

6.34 Propane-Fuelled Engines in Buildings***Intent and Rationale — Clause 6.34***

The requirements of Clause 6.34 are intended to provide safe operation and servicing of propane-fuelled engines that are installed in buildings.

Propane is heavier than air, hence special considerations must be given to the installation of propane-fuelled engines in buildings.

Clause 6.34.1 recognizes that, in the event of a propane leak, ventilation must be delivered at floor level to avoid pooling of propane at dangerous concentrations.

Clause 6.34.2 provides special requirements for engines installed in rooms below grade to ensure that the space is continuously mechanically ventilated in the event of a propane or exhaust leak. Failure of the mechanical ventilation system must shut down the engine.

Clause 6.34.3 deals with the minimum fire separation ratings for the room enclosing the engine to provide a level of fire safety comparable to that required under the *National Building Code of Canada*.

Clauses 6.34.4 and 6.34.5 restrict the means of safely exhausting the products of combustion to the outdoors.

Clause 6.34.6 ensures that the relief of propane is only to the outdoors in accordance with applicable Code requirements.

Clause 6.34.7 provides a means of shutting off the propane supply to the engine when it is shut off or not running. Two solenoid valves in series that are wired in parallel represent a high factor of safety in the event that one of the valves malfunctions.

Clause 6.34.8 requires a flexible connection to the propane-fuelled engine to reduce the potential for damage. A rigid piping or tubing system connecting directly to the engine is more susceptible to damage by vibration and is therefore prohibited.

Clauses 6.34.9 to 6.34.11 deal with the safe means of exhausting the engine.



Looking Back

Review the accessibility requirements in Clause 3.14 prior to installing any appliance. In many cases, accessibility requirements will override requirements for clearance to combustibles.

Minimum Clearances to Combustibles for Appliances Listed in Clause 6			
Type of appliance	Clearance, in (mm)		
	Above ¹	Sides and Rear	Front ²
Boiler	18 (450)	18 (450)	48 (1200)
Central furnace	1 (25)	6 (150)	24 (600)
Forced air conversion furnace	1 (25)	6 (150)	24 (600)
Gravity conversion furnace	6 (150)	6 (150)	24 (600)
Duct furnace	6 (150) / 6 (150)	6 (150)	24 (600)
Horizontal furnace	6 (150) / 6 (150)	6 (150)	24 (600)
Circulating-type room heater	36 (900)	6 (150)	24 (600)
Radiant-type room heater	36 (900)	6 (150)	24 (600)
Swimming pool heater	18 (450)	18 (450)	48 (1200)
Commercial dryer	18 (450)	18 (450)	18 (450)
Domestic dryer	6 (150)	6 (150)	24 (600)
Under fired water heater	2 (50)	2 (50)	2 (50)
Direct vent water heater	2 (50)	2 (50)	36 (900)
Instantaneous water heater	6 (150)	6 (150)	6 (150)
Commercial cooking appliance	36 (900) / 4 (100)	6 (150)	N/A
Residential-type range	30 (750)	6 (150)	48 (1200)
Counter appliance	36 (900)	6 (150)	6 (150)
Hotplate	30 (750)	6 (150)	6 (150)
Incinerator	12 (300)	12 (300)	12 (300)
Lighting bracket or pendant type	18 (450)	5 (125)	5 (125)
Refrigerators	12 (300)	2 (50)	N/A

¹ Distances for clearances below the appliance appear following a solidus (/).

² Front refers to the burner side of the appliance.

N/A indicates that the clearance may be determined by accessibility and service requirements. See Clause 3.

7. VENTING SYSTEMS AND AIR SUPPLY FOR APPLIANCES

Clause 7 of the B149.1 Code provides requirements for venting systems and air supply for appliances. Careful consideration of these requirements is recommended prior to the specification and installation of appliances, since the methods of venting and air supply required by specific appliances may render them impractical in some situations.

Always consider venting and air supply requirements together, because different requirements apply to natural draft and fan-assisted appliances versus, for example, induced draft and direct vent appliances. When natural

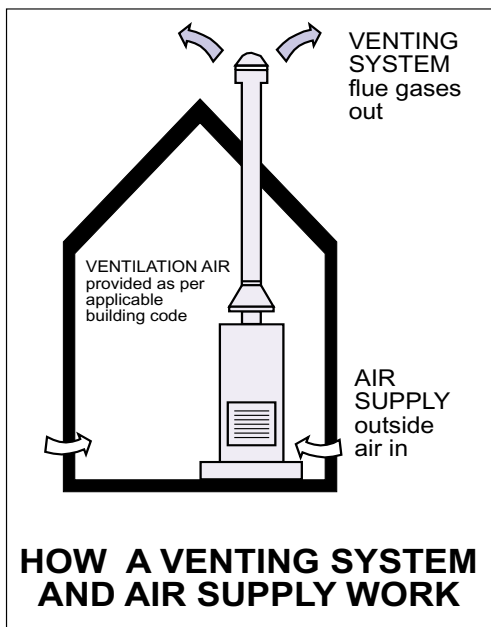
draft and fan-assisted type appliances are being installed, it is also necessary to determine the airtightness of the building envelope and to consider any large capacity air exhausting appliances operating in the building or enclosure where the appliances are located.

A number of other factors must also be considered relating to clearances to combustible materials, the suitability of vent and chimney types, and the termination of vents or chimneys. A well-planned and integrated venting system and air supply will provide an economical installation, which ensures effective venting and proper appliance performance.

Key Points

- Plan all venting and air supply requirements prior to appliance installation.
- Always check the manufacturer's certified installation instructions against Code requirements.
- When unsure, consult with the authority having jurisdiction.
- Use the requirements in Appendix C of the B149.1 Code to size venting systems serving natural draft and/or fan-assisted appliances.

PRINCIPLES OF VENTING SYSTEMS AND AIR SUPPLY



BASIC REVIEW CHECKLIST

The items identified below should be carefully checked when planning and installing venting systems and air supply. Always review manufacturer's installation instructions and check all additional building code requirements that may apply:

- air supply
- air exhausting appliances
- vent and chimney suitability
- approved method of venting
- vent sizing
- vent connection and support
- venting arrangement
- clearance to combustibles
- vent termination

The installation of gas appliances involves a large number of systems that must be properly integrated. All systems, such as pressure controls and piping, are important to consider; however, the venting system and air supply are particularly important for the safe and efficient operation of appliances.

In practice, the venting system and air supply must be considered together, because what goes out the vent is equal to what comes in the air supply. Whenever this principle of operation, known as continuity of flow, is not observed, performance problems may arise. Code requirements are intended to balance the flow in with the flow out, to ensure complete combustion and proper venting. The requirements are based on the tightness of the building envelope, the total input of installed appliances, and whether or not these appliances have draft control devices.

The Code distinguishes between typical venting and air supply requirements, and special venting systems. Special venting systems are installed according to manufacturer's instructions and usually deal with both the venting system and air supply. For example, direct vent appliances generally require a special venting and air supply system to address both requirements. Typical venting and air supply requirements usually deal with appliances that have draft control devices or are fan-assisted, and are connected to a Type B vent or a chimney flue.

In addition to requirements for venting systems and air supply, a number of other factors must be considered, such as vents serving two or more appliances, vents passing through combustible materials, and vent termination. These have been included in a basic review checklist in the box to the left.

The clauses of the handbook that follow provide additional information and examples intended to assist installers and regulatory officials to apply the requirements for venting systems and air supply properly and consistently.

7. VENTING SYSTEMS AND AIR SUPPLY FOR APPLIANCES

7.1 General

Intent and Rationale — Clause 7.1

Clause 7.1 provides a general description of the application of the requirements of Clause 7 to air supply for appliances and venting systems. Clause 7 is divided into sections dealing with distinct aspects of venting systems and air supply for appliances.

Clauses 7.2 through 7.8 inclusive deal with air supply for appliances.

Clauses 7.9 through 7.21 inclusive cover requirements for vents, vent connectors, chimneys, and chimney connections.

Clauses 7.22 through 7.30 inclusive deal with dampers, draft hoods and regulators, draft devices, and venting arrangements, including venting of appliances into canopies.

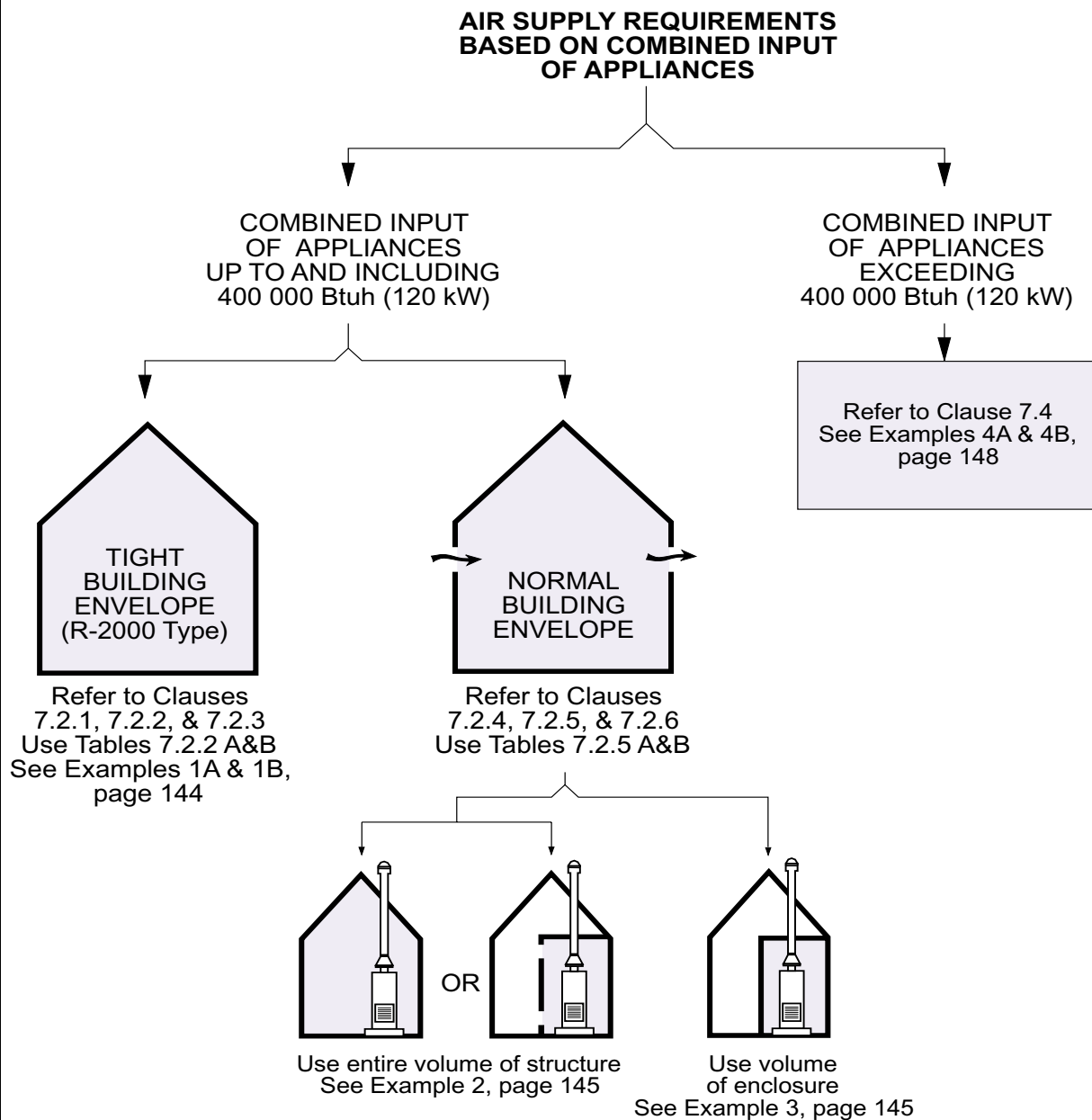
Clause 7.31 is specifically intended for heat reclaimers extracting heat from flue gases.

The rationale for these distinct requirements is conveyed in terms of their application, with the exception of air supply requirements. For this reason, Clause 7.1 breaks down the application of air supply requirements in Clauses 7.2 through 7.5 inclusive, based on the characteristics of the appliance(s) being vented. It also provides a general requirement prohibiting interference with any appliance air supply.

Refer to the figure on the following page, which illustrates the practical application of air supply requirements for appliances in Clause 7.

DETERMINING AIR SUPPLY REQUIREMENTS

The flowchart illustrated below can be used to determine the applicable air supply requirements for any particular installation.



Gas Burning Appliances, Envelope Airtightness, and Air Supply

Buildings have become increasingly airtight with the introduction of new building materials and techniques. The trend toward tighter envelopes accelerated due to concerns for energy efficiency and conservation in the 1970s. With the introduction of R-2000 homes, extremely airtight envelopes were recognized as potentially affecting traditional gas appliance performance.

Increased envelope airtightness may adversely affect the normal operation of combustion appliances, which coexisted well within the relatively leaky building envelopes of the past. Understanding the operation and air requirements of combustion appliances in conjunction with other air-exhausting equipment installed in today's buildings is essential to minimize conditions that may affect appliance performance and potentially the health and safety of the occupants.

In new housing, the 1995 *National Building Code of Canada* requires that depressurization is limited to 5 Pa in order to eliminate the risk of combustion appliance spillage. This responsibility usually rests with the ventilation system installer, who is also often the gas appliance installer (heating contractor). The industry now has access to training and methods to ensure this building code requirement is met, and, provided these methods are employed, the risk of spillage problems may be considered insignificant.

The practical difficulty that remains for the installer, however, is determining whether a building is sufficiently tight to require an outside combustion/dilution air supply. This is particularly difficult when dealing with an existing building that has been renovated or retrofitted. While a fan depressurization test will determine whether the equivalent leakage area is less than 78 in² (see 7.2.1 (b)), not all installers own or have access to this equipment. Ensuring that a building conforms to the description in Clause 7.2.1(a) of the B149.1 Code may be difficult, since often it is concluded that the building is airtight, based on the similarity of this description with 1995 NBCC requirements for air barriers.

Surveys conducted by the Canada Mortgage and Housing Corporation (CMHC) for new housing built in Canada indicate that only a small percentage of homes are tight enough to require outside combustion/dilution air. These are usually homes of the R-2000 type where a great deal of care has been taken to air seal the building envelope. As a rule-of-thumb, unless a dwelling is of the R-2000 type, combustion/dilution air supply may be determined using Tables 7.2.5A and B. Usually there is no requirement for outside air supply unless the building is extremely small.

On the other hand, where appliances are located in a sealed enclosure without openings communicating with the rest of the building, an outside supply of combustion/dilution air will almost always be required. This is due to the fact that the small volume and surface area of the enclosure is unable to provide adequate air supply through air leakage. For this situation, the volume of the enclosure and Tables 7.2.5 A and B should be used to determine air supply requirements. Providing openings in the enclosure that communicate with the rest of the building structure will often eliminate the need for outside air supply since the total volume of the structure may be used when consulting the tables.

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

7.2 Air Supply Determination for Central Heating Furnaces, Boilers, and Hot Water Heaters

7.2.1 An outdoor *air supply* sized in accordance with Clause 7.2.2 shall be provided to either an *enclosure* or a *structure* in which an *appliance(s)* is installed when the *structure* either

- (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 similar materials having sealed joints; or
- (b) has an equivalent leakage area of 78 in² (0.05 m²) or less at a differential pressure of 0.00145 psig (10 Pa) as determined by the recognized Canadian fan depressurization test procedure.

Intent and Rationale — Clause 7.2.1

Clause 7.2.1 is intended to provide criteria for determining the need for a dedicated outside air supply serving central heating furnaces, boilers, and hot water heaters having a total input up to and including 400 000 Btuh (120 kW).

Traditionally, building construction was sufficiently loose with respect to air leakage to provide an adequate amount of combustion and dilution air to typically installed gas appliances. As building envelopes have become tighter, conditions may exist where natural air infiltration does not provide sufficient air supply. Clause 7.2.1(a) is a visual description of the criteria in Clause 7.2.1(b). For practical purposes, these criteria typically apply to any building constructed to R-2000 (airtight envelope) requirements or of a similar type of new construction. R-2000 type buildings must be provided with an air supply in accordance with Clause 7.2.2. The requirements of Clause 7.3 for air supply openings and ducts must also be applied in this case.

Caution should also be exercised when dealing with building retrofits where new windows have been installed, the basement has been

finished, or air sealing has been performed, particularly in smaller homes. An outside air supply to buoyancy vented appliances may become necessary.

Clause 7.2.1 is not intended to apply to typical new construction or existing homes since this level of airtightness is seldom achieved in practice.

7.2.2 Except as permitted in Clause 7.2.3, the free area of the outdoor *air supply* required by Clause 7.2.1 shall be determined from Table 7.2.2A for an *appliance(s)* having a *draft control device* and from Table 7.2.2B for an *appliance(s)* not having a *draft control device*, using the total input of all *appliances* in either the *structure* or *enclosure*. If an *appliance* with a *draft control device* and an *appliance* without a *draft control device* are installed within the same *structure* or *enclosure*, the required free area of the *air supply* opening shall be the greater of either

- (a) that required by Table 7.2.2A, using the total input of only those *appliances* having *draft control devices*; or
- (b) that required by Table 7.2.2B, using the total input of all *appliances*.

Intent and Rationale — Clause 7.2.2

Clause 7.2.2 is intended to provide the basis for sizing air supply to appliances with inputs up to and including 400 000 Btuh (120 kW) when the building structure complies with Clause 7.2.1 (a) or (b).

Appliances installed in tight building structures that require an outdoor air supply may have a draft control device (natural or fan-assisted) or may not have a draft control device (induced or forced). The former type requires both combustion and dilution air and must be sized in accordance with Table 7.2.2A, while the latter only requires combustion air and is sized in accordance with Table 7.2.2B. The required size of the air supply opening is based on the total input of appliances and the draft control characteristics of the appliances. In all cases, it

is assumed that practically no air is supplied to the appliance(s) by natural air leakage. Where both types of appliances are installed in a building structure or enclosure, the required size of air supply opening is based on the greater of either the size required by Table 7.2.2A using the total input of only those appliances having draft control devices, or the size required by Table 7.2.2B, using the total input of all appliances. This requirement reflects the dominant importance of dilution air for proper venting and the conservative assumption for air supply opening sizes in the tables. The figures in the tables are based on a maximum equivalent duct length of 20 ft, and where this is exceeded up to a maximum equivalent length of 50 ft, the round duct diameter must be increased by one size to compensate for increased pipe friction losses. Mechanical means of ensuring air supply must be used where the equivalent length of supply air ducting exceeds 50 ft.

7.2.3 An outdoor *air supply* is not required for a single water heater with an input of 50 000 Btuh (15 kW) or less where there are no other *appliances* within either an *enclosure* or *structure* that require an *air supply*.

Intent and Rationale — Clause 7.2.3

The intent of Clause 7.2.3 is to provide an exception to air supply requirements for limited input, single water heaters installed where no other gas appliances require an air supply.

Water heaters, unlike furnaces, seldom operate continuously. Their operation is governed by demand for hot water (typically about 2 h per day). When a single water heater is installed, and there are no other gas appliances requiring an air supply, past experience has shown that an outside air supply is not required.

Table 7.2.2A Combustion/Dilution Air Requirements for Appliances Having Draft Control Devices When the Combined Input Is Up to and Including 400 000 Btuh (120 kW) and the Structure Complies with Clause 7.2.1 (a) or (b)		
Total input of appliance* Thousands of Btuh (kW)	Required free area of air supply opening or duct in² (mm²)	Acceptable approximate round duct equivalent† diameter in (mm)
25 (8)	7 (4 500)	3 (75)
50 (15)	7 (4 500)	3 (75)
75 (23)	11 (7 000)	4 (100)
100 (30)	14 (9 000)	4 (100)
125 (37)	18 (12 000)	5 (125)
150 (45)	22 (14 000)	5 (125)
175 (53)	25 (16 000)	6 (150)
200 (60)	29 (19 000)	6 (150)
225 (68)	32 (21 000)	6 (150)
250 (75)	36 (23 000)	7 (175)
275 (83)	40 (26 000)	7 (175)
300 (90)	43 (28 000)	7 (175)
325 (98)	47 (30 000)	8 (200)
350 (105)	50 (32 000)	8 (200)
375 (113)	54 (35 000)	8 (200)
400 (120)	58 (37 000)	9 (225)
* For total inputs falling between listed figures, use next largest listed input. † These figures are based on a maximum equivalent duct length of 20 ft (6 m). For equivalent duct lengths in excess of 20 ft (6 m) up to and including a maximum of 50 ft (15 m), increase round duct diameter by one size.		

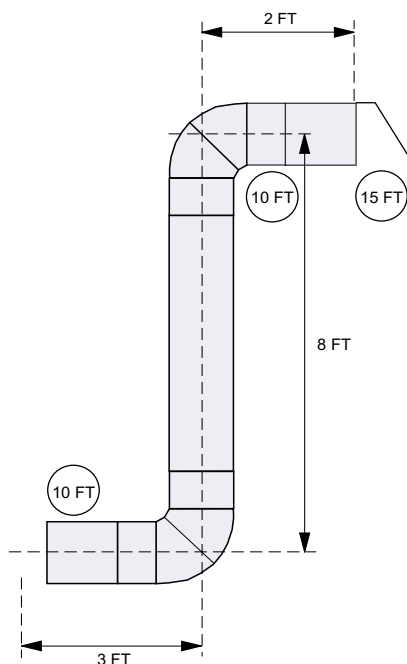
Table 7.2.2B Combustion Air Requirements for Appliances NOT Having Draft Control Devices When the Combined Input Is Up to and Including 400 000 Btuh (120 kW) and the Structure Complies with Clause 7.2.1 (a) or (b)		
Total input of appliance* Thousands of Btuh (kW)	Required free area of air supply opening or duct in² (mm²)	Acceptable approximate round duct equivalent† diameter in (mm)
25 (8)	4 (2 600)	2 (50)
50 (15)	4 (2 600)	2 (50)
75 (23)	5 (3 200)	3 (75)
100 (30)	7 (4 500)	3 (75)
125 (37)	9 (5 800)	4 (100)
150 (45)	11 (7 000)	4 (100)
175 (53)	13 (8 400)	4 (100)
200 (60)	14 (9 000)	5 (125)
225 (68)	16 (10 300)	5 (125)
250 (75)	18 (12 000)	5 (125)
275 (83)	20 (13 000)	5 (125)
300 (90)	22 (14 000)	6 (150)
325 (98)	23 (15 000)	6 (150)
350 (105)	25 (16 000)	6 (150)
375 (113)	27 (17 400)	6 (150)
400 (120)	29 (19 000)	6 (150)
* For total inputs falling between listed figures, use next largest listed input. † These figures are based on a maximum equivalent duct length of 20 ft (6 m). For equivalent duct lengths in excess of 20 ft (6 m) up to and including a maximum of 50 ft (15 m), increase round duct diameter by one size.		

EFFECTIVE LENGTH OF AIR SUPPLY DUCTS

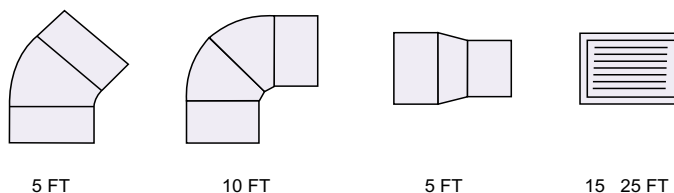
Tables 7.2.2 A and B are used to size the outside air supply and are limited to a maximum effective duct length of 50 ft (see the second note at the bottom of these tables, and substitute "effective" for "equivalent"). Beyond this length of resistance, some form of mechanical air supply should be considered.

The effective length of a duct is calculated by determining its actual and equivalent lengths. The actual length can be measured and the equivalent length of the fittings and grilles added to obtain the effective length. 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 $3\text{ ft} + 8\text{ ft} + 2\text{ ft} = 13\text{ ft}$. The equivalent length (shown in the circles) is equal to $10\text{ ft} + 10\text{ ft} + 15\text{ ft} = 35\text{ ft}$. The effective length is equal to $13\text{ ft} + 35\text{ ft} = 48\text{ ft}$.

Because the effective length of the duct is greater than 20 ft, the diameter of the duct would have to be increased to 1 size larger than that required in the tables. If the duct had exceeded 50 ft, then another means of providing outside air would be required.



EQUIVALENT LENGTH OF COMMON FITTINGS AND GRILLES



DOUBLE THE LENGTH FOR ALL CORRUGATED DUCTWORK

Table 7.2.5A Combustion/Dilution Air Requirements for Appliances Having Draft Control Devices When the Combined Input Is Up to and Including 400 000 Btuh (120 kW) and the Structure Does NOT Comply with Clause 7.2.1 (a) or (b)															
Total input of appliances*, thousands of Btuh (kW)	Volume of the enclosure or structure, ft ³ (m ³)														
	500	1000	2000	3000	4000	5000	6000	7000	8000	9000	10 000	12 500	15 000	17 500	20 000
	(14)	(28)	(57)	(85)	(113)	(142)	(170)	(198)	(227)	(255)	(283)	(354)	(425)	(495)	(566)
Required air supply opening† in ² (thousands of mm ²)															
25 (8)	4 (3)	4 (3)	0	0	0	0	0	0	0	0	0	0	0	0	0
50 (15)	7 (5)	7 (5)	7 (5)	0	0	0	0	0	0	0	0	0	0	0	0
75 (23)	11 (7)	11 (7)	11 (7)	11 (7)	11 (7)	0	0	0	0	0	0	0	0	0	0
100 (30)	14 (9)	14 (9)	14 (9)	14 (9)	14 (9)	14 (9)	0	0	0	0	0	0	0	0	0
125 (37)	18 (12)	18 (12)	18 (12)	18 (12)	18 (12)	18 (12)	18 (12)	18 (12)	0	0	0	0	0	0	0
150 (45)	22 (14)	22 (14)	22 (14)	22 (14)	22 (14)	22 (14)	22 (14)	22 (14)	22 (14)	0	0	0	0	0	0
175 (53)	25 (16)	25 (16)	25 (16)	25 (16)	25 (16)	25 (16)	25 (16)	25 (16)	25 (16)	25 (16)	25 (16)	0	0	0	0
200 (60)	29 (19)	29 (19)	29 (19)	29 (19)	29 (19)	29 (19)	29 (19)	29 (19)	29 (19)	29 (19)	29 (19)	0	0	0	0
225 (68)	32 (21)	32 (21)	32 (21)	32 (21)	32 (21)	32 (21)	32 (21)	32 (21)	32 (21)	32 (21)	32 (21)	32 (21)	0	0	0
250 (75)	36 (23)	36 (23)	36 (23)	36 (23)	36 (23)	36 (23)	36 (23)	36 (23)	36 (23)	36 (23)	36 (23)	36 (23)	0	0	0
275 (83)	40 (26)	40 (26)	40 (26)	40 (26)	40 (26)	40 (26)	40 (26)	40 (26)	40 (26)	40 (26)	40 (26)	40 (26)	40 (26)	0	0
300 (90)	43 (28)	43 (28)	43 (28)	43 (28)	43 (28)	43 (28)	43 (28)	43 (28)	43 (28)	43 (28)	43 (28)	43 (28)	43 (28)	43 (28)	0
325 (98)	47 (30)	47 (30)	47 (30)	47 (30)	47 (30)	47 (30)	47 (30)	47 (30)	47 (30)	47 (30)	47 (30)	47 (30)	47 (30)	47 (30)	0
350 (105)	50 (32)	50 (32)	50 (32)	50 (32)	50 (32)	50 (32)	50 (32)	50 (32)	50 (32)	50 (32)	50 (32)	50 (32)	50 (32)	50 (32)	50 (32)
375 (113)	54 (35)	54 (35)	54 (35)	54 (35)	54 (35)	54 (35)	54 (35)	54 (35)	54 (35)	54 (35)	54 (35)	54 (35)	54 (35)	54 (35)	54 (35)
400 (120)	58 (37)	58 (37)	58 (37)	58 (37)	58 (37)	58 (37)	58 (37)	58 (37)	58 (37)	58 (37)	58 (37)	58 (37)	58 (37)	58 (37)	58 (37)
* For total inputs falling between listed figures, use next largest input.															
† See Table 7.2.2A for acceptable approximate round duct equivalent.															

Table 7.2.5B Combustion Air Requirements for Appliances NOT Having Draft Control Devices When the Combined Input Is Up to and Including 400 000 Btuh (120 kW) and the Structure Does NOT Comply with Clause 7.2.1 (a) or (b)															
Total input of appliances*, thousands of Btuh (kW)	Volume of the enclosure or structure, ft ³ (m ³)														
	500	1000	2000	3000	4000	5000	6000	7000	8000	9000	10 000	12 500	15 000	17 500	20 000
	(14)	(28)	(57)	(85)	(113)	(142)	(170)	(198)	(227)	(255)	(283)	(354)	(425)	(495)	(566)
Required air supply opening† in ² (thousands of mm ²)															
25 (8)	2 (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50 (15)	4 (3)	4 (3)	0	0	0	0	0	0	0	0	0	0	0	0	0
75 (23)	5 (3)	5 (3)	5 (3)	0	0	0	0	0	0	0	0	0	0	0	0
100 (30)	7 (5)	7 (5)	7 (5)	0	0	0	0	0	0	0	0	0	0	0	0
125 (37)	9 (6)	9 (6)	9 (6)	9 (6)	0	0	0	0	0	0	0	0	0	0	0
150 (45)	11 (7)	11 (7)	11 (7)	11 (7)	11 (7)	0	0	0	0	0	0	0	0	0	0
175 (53)	13 (8)	13 (8)	13 (8)	13 (8)	13 (8)	13 (8)	0	0	0	0	0	0	0	0	0
200 (60)	14 (9)	14 (9)	14 (9)	14 (9)	14 (9)	14 (9)	0	0	0	0	0	0	0	0	0
225 (68)	16 (10)	16 (10)	16 (10)	16 (10)	16 (10)	16 (10)	16 (10)	0	0	0	0	0	0	0	0
250 (75)	18 (12)	18 (12)	18 (12)	18 (12)	18 (12)	18 (12)	18 (12)	18 (12)	0	0	0	0	0	0	0
275 (83)	20 (13)	20 (13)	20 (13)	20 (13)	20 (13)	20 (13)	20 (13)	20 (13)	20 (13)	0	0	0	0	0	0
300 (90)	22 (14)	22 (14)	22 (14)	22 (14)	22 (14)	22 (14)	22 (14)	22 (14)	22 (14)	0	0	0	0	0	0
325 (98)	23 (15)	23 (15)	23 (15)	23 (15)	23 (15)	23 (15)	23 (15)	23 (15)	23 (15)	23 (15)	23 (15)	0	0	0	0
350 (105)	25 (16)	25 (16)	25 (16)	25 (16)	25 (16)	25 (16)	25 (16)	25 (16)	25 (16)	25 (16)	25 (16)	25 (16)	0	0	0
375 (113)	27 (17)	27 (17)	27 (17)	27 (17)	27 (17)	27 (17)	27 (17)	27 (17)	27 (17)	27 (17)	27 (17)	27 (17)	27 (17)	0	0
400 (120)	29 (19)	29 (19)	29 (19)	29 (19)	29 (19)	29 (19)	29 (19)	29 (19)	29 (19)	29 (19)	29 (19)	29 (19)	29 (19)	29 (19)	0
* For total inputs falling between listed figures, use next largest input.															
† See Table 7.2.2A for acceptable approximate round duct equivalent.															

7.2.4 An outdoor *air supply* sized in accordance with Clause 7.2.5 shall be provided to either an *enclosure* or a *structure* in which an *appliance(s)* is installed when the *structure* is neither constructed as described in Clause 7.2.1(a) nor complies with Clause 7.2.1(b).

7.2.5 The free area of the outdoor *air supply* required by Clause 7.2.4 shall be determined from Table 7.2.5A for an *appliance(s)* having a *draft control device* and Table 7.2.5B for an *appliance(s)* not having a *draft control device*, using the total input of all *appliances* in either the *structure* or *enclosure*. If an *appliance* with a *draft control device* and an *appliance* without a *draft control device* are installed within the same *structure* or *enclosure*, the required free area of the *air supply* opening shall be the greater of either

- (a) that required by Table 7.2.5A, using the total input of only those *appliances* having *draft control devices*; or
- (b) that required by Table 7.2.5B, using the total input of all *appliances*.

Intent and Rationale — Clauses 7.2.4 and 7.2.5

Clauses 7.2.4 and 7.2.5 are intended to provide the basis for sizing air supply to appliances with inputs up to and including 400 000 Btuh (120 kW) when the building structure is of normal airtightness.

In buildings or enclosures of normal construction, requirements for air supply are dependent on the total input of the appliances, the draft control characteristics of the appliances, and the volume of the enclosure or structure. Note that, while not explicitly stated in the Clauses and accompanying Tables, enclosures or structures of normal construction with volumes greater than 20 000 ft³ do not generally require an outdoor air supply. For appliances installed in enclosures, also refer to Clause 7.2.6.

7.2.6 When an *appliance(s)* is located within an *enclosure* and permanent openings sized and located in accordance with Items (a) and (b) below

are supplied to allow communication between the *enclosure* and the rest of the *structure*, the total volume of the *structure* may be used to determine *air supply* requirements, provided that the *structure* is neither constructed as described in Clause 7.2.1(a), and does not comply with Clause 7.2.1(b). Otherwise, the volume of the *enclosure* shall be used.

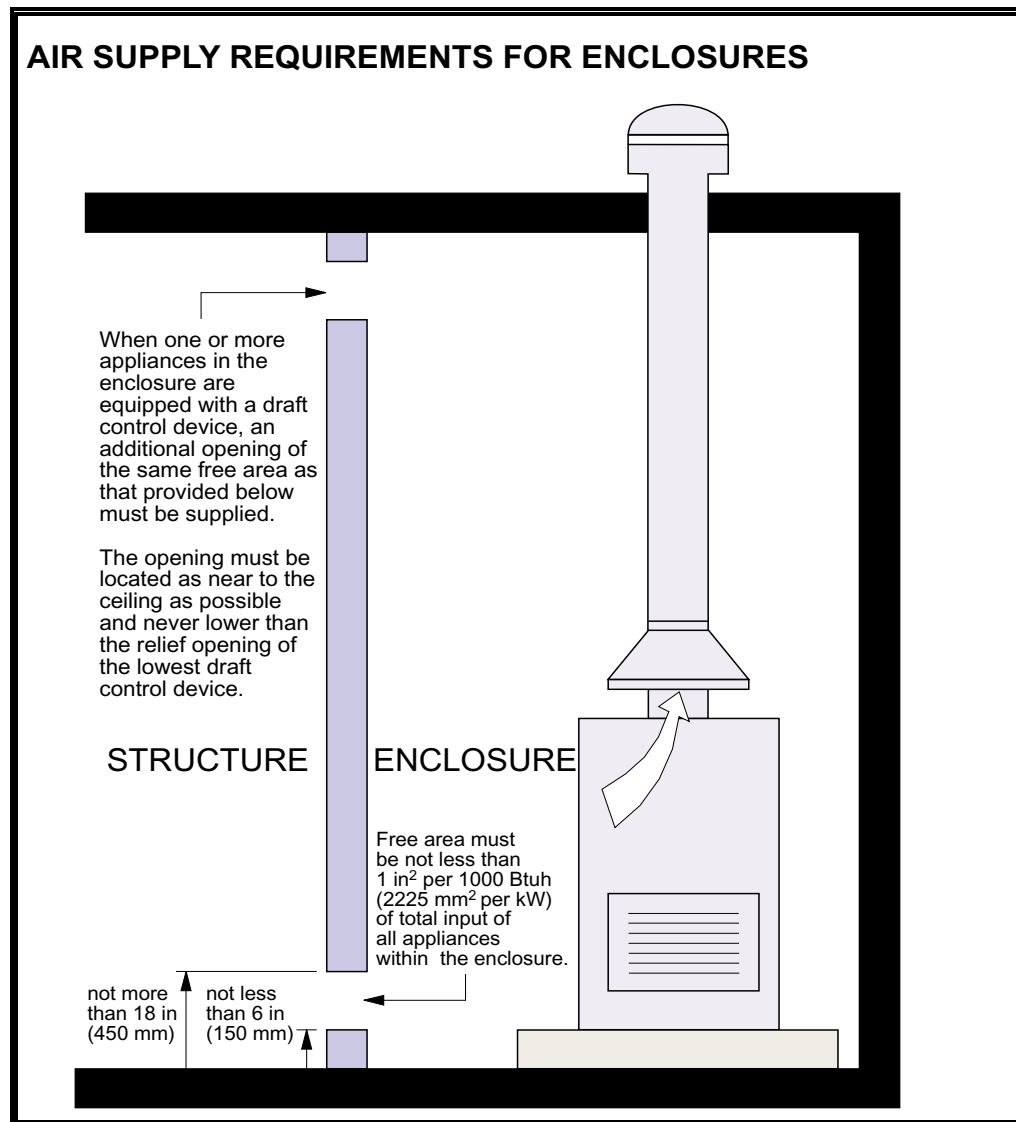
- (a) In all cases, an opening shall be provided that shall
 - (i) have a free area of not less than 1 in² per 1000 Btuh (2225 mm² per kW) of the total input of all *appliances* within the *enclosure*; and
 - (ii) be located neither more than 18 in (450 mm), or less than 6 in (150 mm) above floor level.
- (b) When one or more *appliances* are equipped with *draft control devices*, an additional opening shall be supplied having the same free area as the opening required in Item (a), and the opening shall be located as near the ceiling as practicable, but in no case lower than the relief opening of the lowest *draft control device*.

Intent and Rationale — Clause 7.2.6

The requirements of this Clause are intended to provide criteria for the determination of the volume to be used when applying the requirements of Clauses 7.2.4 and 7.2.5 for enclosures housing appliances within structures.

In order to correctly apply the requirements of Clauses 7.2.4 and 7.2.5 for air supply to appliances located in an enclosure within a loose structure, it is necessary to determine, in Tables 7.2.5A and 7.2.5B, whether the volume of the enclosure only or of the entire structure may be used. The entire volume of the structure may be used when permanent openings are provided in accordance with Clauses 7.2.6 (a) and (b). The sizing of these openings is based on the findings of AGA Research Bulletin #53, *The Effects of Confined Space Installation on Central Gas Space Heating Performance*, published in 1947.

When the enclosure is not provided with such openings, only the volume of the enclosure may be used in Tables 7.2.5A and 7.2.5B. Given the relatively large size of air supply openings required for appliances in small enclosures and the additional requirements for air supply openings in Clause 7.3, it may be preferable to provide openings between the enclosure and the structure.



7.3 Air Supply Openings and Ducts

7.3.1 Except as specified in Clauses 7.3.3 and 7.3.4, a duct shall be used to provide the outside **air supply** required by Clauses 7.2.1 and 7.2.4. The duct shall

- (a) be of either metal or a material meeting the Class I requirements of ULC Standard CAN/ULC-S110;
- (b) communicate directly with the outdoors;
- (c) be of at least the same cross-sectional area as the free area of the **air supply** inlet opening to which it connects; and
- (d) terminate within 1 ft (300 mm) above, and within 2 ft (600 mm) horizontally from, the **burner** level of the **appliance** having the largest input.

Intent and Rationale — Clause 7.3.1

Clause 7.3.1 is intended to prescribe the general requirements for outside air supply provided to appliances as required by Clauses 7.2.1 and 7.2.4.

The requirements of Clause 7.3.1 apply to appliances with a total input up to and including 400 000 Btuh (120 kW) located in any type of structure or enclosure, with exceptions as noted. Air supply must be provided using a suitable air duct with a cross-sectional area not less than that of the air supply inlet to which it is connected. These requirements ensure that the minimum free area of the air supply opening is maintained along a passage with an acceptable level of friction against air flow. The duct must lead directly to the outdoors to ensure an uncontaminated air supply. The duct must terminate within 1 ft above, and within 2 ft horizontally from the burner level of the appliance having the largest input. This requirement ensures that the air supply is dedicated to the appliance(s) served and may be directly accessed without interfering influence from other equipment in the structure that also demands outside air.

7.3.2 A square- or rectangular-shaped duct shall only be used when the required free area of the **air supply** opening is 9 in² (5800 mm²) or larger, and when used, its smaller dimension shall not be less than 3 in (75 mm).

Intent and Rationale — Clause 7.3.2

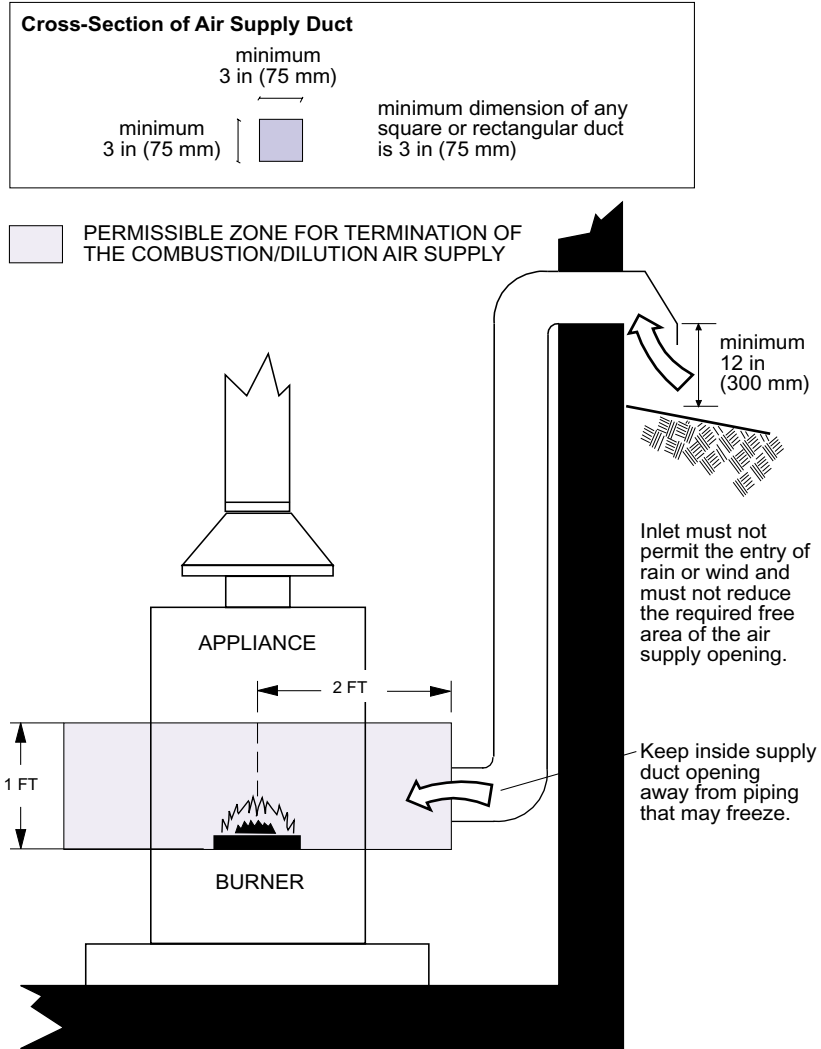
The intent of this requirement is to prohibit the use of small, narrow rectangular or square-shaped ducts.

Rectangular- and square-shaped ducts have higher friction resistance to air flow than round ducts, due to the higher ratio of interior surface area to cross-sectional area. When a dimension on a rectangular- or square-shaped duct is smaller than 3 in, the turbulence at the inlet begins to significantly impede air flow. In practical terms, this means that any square or rectangular duct smaller than 3 in by 3 in cannot be used to reliably deliver outside air to appliances. For this reason, round ducts must always be used when the required free area is less than 9 in². When the required free area is equal to, or greater than 9 in², rectangular ducts may be used provided the minimum dimension is at least 3 in. Round ducts are permitted for any required free area.

7.3.3 An opening may be used in lieu of a duct to provide the outside **air supply** to an **appliance(s)** as required by Clauses 7.2.1 and 7.2.4, and the opening shall be located within 1 ft (300 mm) above, and 2 ft (600 mm) horizontally from, the **burner** level of the **appliance** having the largest input.

7.3.4 Certified combustion air supply equipment may be used in lieu of a duct to provide the outside **air supply** to an **appliance** as required in Clauses 7.2.1 and 7.2.4.

AIR SUPPLY DUCT TERMINATION REQUIREMENTS



Intent and Rationale — Clauses 7.3.3 and 7.3.4

Clauses 7.3.3 and 7.3.4 are intended to provide exceptions to the air supply requirements of Clauses 7.3.1 and 7.3.2.

In some cases, an appliance is located where an opening to the outside may adequately supply the required outside air. The opening must be located within 1 ft above, and 2 ft horizontally from, the burner level of the appliance having the largest input. In other cases (if, for example, the outside air supply duct exceeded an equivalent length of 50 ft), mechanical air supply is required.

7.3.5 An *air supply* inlet opening from the outdoors shall be equipped with a means to prevent the direct entry of rain and wind, and such means shall not reduce the required free area of the *air supply* opening.

7.3.6 An *air supply* inlet opening from the outdoors shall be located not less than 12 in (300 mm) above the outside grade level.

Intent and Rationale — Clauses 7.3.5 and 7.3.6

Clauses 7.3.5 and 7.3.6 are intended to provide requirements for the weather resistance of outside air supply inlets.

Air supply inlets must provide a controlled means of admitting air while preventing the entry of rain and wind. Further, Clause 6 of the 1990 *National Building Code of Canada* requires that any ducts or openings leading from the inside to the outside of a building or enclosure must be fitted with corrosion-resistant screens (see NBCC 6.2.3.13). None of these means may reduce the required free area of the air supply inlet, which must be located a minimum of 12 in above outside grade. A suitable location of the duct termination is recommended when snowfall accumulation exceeds 12 in.

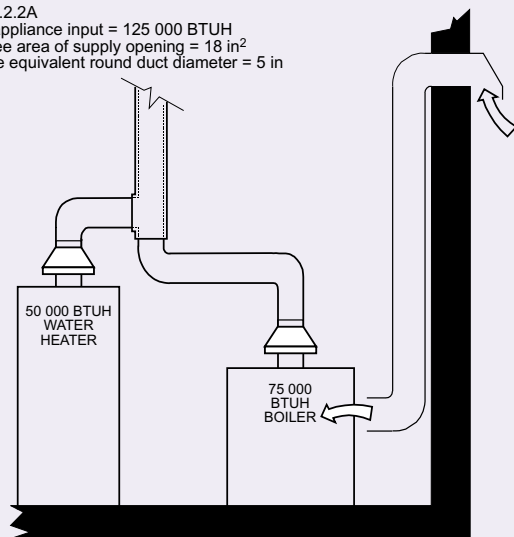
EXAMPLES OF AIR SUPPLY TO APPLIANCES INSTALLED IN AIRTIGHT BUILDINGS

EXAMPLE 1A

BUILDING WITH TIGHT ENVELOPE (R-2000 TYPE)

Both appliances have draft control devices

Use Table 7.2.2A
 Combined appliance input = 125 000 BTUH
 Required free area of supply opening = 18 in²
 Approximate equivalent round duct diameter = 5 in



When gas appliances are installed in buildings with a tight envelope (R-2000 type), an outside air supply must be provided.

If the appliances are all equipped with draft control devices (Example 1A), the procedure is straightforward using Table 7.2.2A.

Where all of the appliances are without draft control devices, a similar procedure is used; however, Table 7.2.2B must be used.

There will be cases where both types of appliances are installed in the same building (Example 1B), in which case the procedure in Clause 7.2.2 (a) and (b) of B149.1 must be followed.

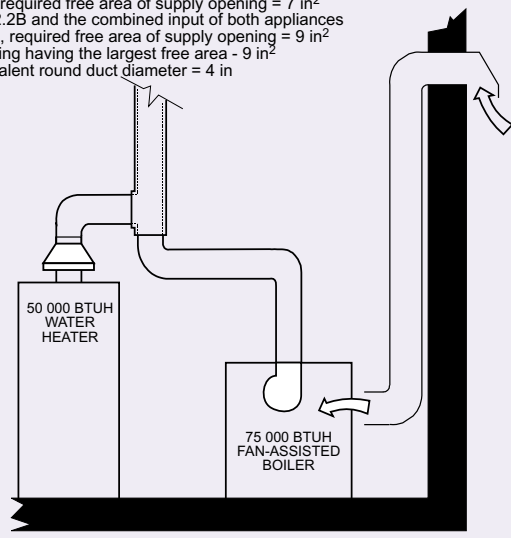
Ensure that the outside air supply duct and its termination conform to the requirements of Clause 7.3.1.

EXAMPLE 1B

BUILDING WITH TIGHT ENVELOPE (R-2000 TYPE)

One appliance with draft control device, one without (fan-assisted)

First, use Table 7.2.2A and input of appliance with draft control device
 For 50 000 BTUH, required free area of supply opening = 7 in²
 Then use Table 7.2.2B and the combined input of both appliances
 For 125 000 BTUH, required free area of supply opening = 9 in²
 Install supply opening having the largest free area - 9 in²
 Approximate equivalent round duct diameter = 4 in



In cold climates, consider providing an outside air supply duct with insulation and a vapour 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.

EXAMPLES OF AIR SUPPLY TO APPLIANCES INSTALLED IN TYPICAL BUILDINGS

EXAMPLE 2

BUILDING WITH NORMAL ENVELOPE AIRTIGHTNESS

Both appliances with draft control device, use Table 7.2.5A

For a volume of 20 000 ft³, no air supply is required

if openings in the enclosure are provided

Calculate openings required in enclosure using Clause 7.2.6 (a) & (b)

Step 1

Free area required by 7.2.6(a)(i) is 1 in² per 1 000 Btuh

For 125 000 Btuh, required free area = 125 in²

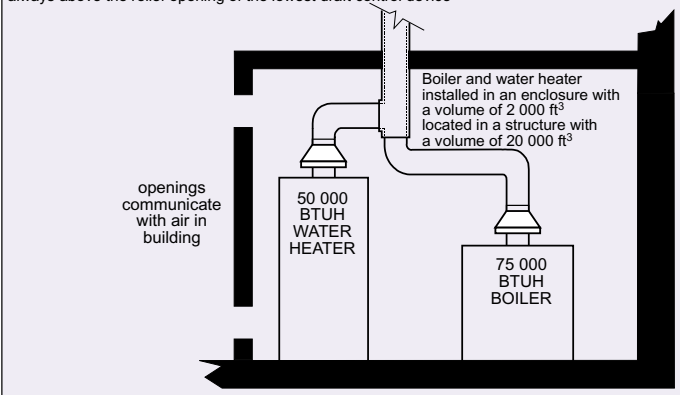
Locate opening between 6 and 18 in above floor level

Step 2

Since appliances are equipped with draft control devices

Clause 7.2.6(b) requires an additional opening of the same size

Locate as near the ceiling as practically possible and always above the relief opening of the lowest draft control device



When gas appliances are installed in a building which is not extremely airtight (typical new housing and existing buildings), the requirements for outside air supply are based on the combined input of the appliances, their draft control characteristics, and the volume of the structure. If the structure has a large enough volume, sufficient air supply is delivered through normal air leakage and no additional openings are required.

In some cases, gas appliances are installed in an enclosure within the building. It is advantageous, if possible, to provide openings in the partition separating the enclosure from the building, since this allows the entire volume of the structure to be used, thereby often avoiding the need for an outside air supply (see Example 2).

EXAMPLE 3

ENCLOSURE WITH SMALL INTERIOR VOLUME

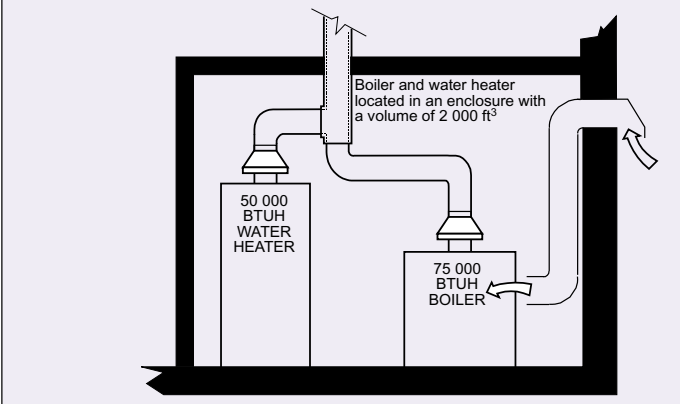
Both appliances with draft control device, use Table 7.2.5 A

For a volume of 2 000 ft³ and a combined input of 125 000 Btuh

the required air supply opening is 18 in².

Refer to Clause 7.3.1 for air supply duct termination requirements.

Note that the required air supply opening calculated for the enclosure is the same as that which results when a very tight envelope is assumed. See Example 1A.



Where openings in the enclosure are not practical (for example, conditions such as excessive dust in the building may impair appliance performance) a separate outside air supply may be required (see Example 3). This is also often the case for appliances installed in very small structures.

7.4 Air Supply Requirements for Appliances Having a Total Input Exceeding 400 000 Btuh (120 kW)

7.4.1 Ventilation of the space occupied by an **appliance** and **equipment** shall be provided by an opening(s) for **ventilation air** at the highest practical point communicating with outdoors. The total cross-sectional area of such an opening(s) shall be at least 10% of the area required in Clauses 7.4.2 and 7.4.3, but in no case shall the cross-sectional area be less than 10 in² (6500 mm²).

Intent and Rationale — Clause 7.4.1

The requirements of Clause 7.4.1 are intended to provide adequate ventilation air to appliances having inputs exceeding 400 000 Btuh (120 kW).

Large input appliances require ventilation of the space in which they are installed to remove leaked or spilled products of combustion (flue gases). The requirement for ventilation air is above and beyond any requirement for an outside air supply providing combustion and dilution air. Locating ventilation openings at the highest practical point communicating with the outdoors ensures that warm air driven by buoyancy forces will exfiltrate from the space.

Note that, in some cases, requirements for ventilation under the applicable building code may allow the ventilation requirements of this Clause to be waived for the appliance installer.

7.4.2 When **air supply** is provided by natural air flow from the outdoors for **natural draft**, partial fan-assisted, fan-assisted, or power draft-assisted **burners**, there shall be a permanent **air supply** opening(s) having a cross-sectional area of not less than 1 in² per 7000 Btuh (310 mm² per kW) up to and including 1 million Btuh, plus 1 in² per 14 000 Btuh (155 mm² per kW) in excess of 1 million Btuh. This opening(s) 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 air opening for **ventilation air** required in Clause 7.4.1. See also Clauses 3.1.4 and 3.1.5.

Intent and Rationale — Clause 7.4.2

Clause 7.4.2 is intended to provide the requirements for outside air supply serving appliances with any type of draft control device.

Appliances having draft control devices require both combustion and dilution air. Their venting depends on buoyancy, and, for this reason, air supply openings must be located near the floor so that the flow of outside air is assisted by its density, which is higher than that of the warmer air in the space where the appliance(s) is located.

7.4.3 When **air supply** is provided by natural air flow from outdoors for a power burner and there is no **draft regulator**, **draft hood**, or similar **flue gas** dilution device installed in the same space, in addition to the opening for **ventilation air** required in Clause 7.4.1, there shall be a permanent **air supply** opening(s) having a total cross-sectional area of not less than 1 in² for each 30 000 Btuh (70 mm² per kW) of the total rated input of the **burner(s)**, and the location of the opening(s) shall not interfere with the intended purpose of the opening(s) for the **ventilation air** referred to in Clause 7.4.1. See also Clauses 3.1.4 and 3.1.5.

Intent and Rationale — Clause 7.4.3

Clause 7.4.3 is intended to provide the requirements for outside air supply serving appliances without draft control devices.

Appliances without draft control devices require only combustion air. The venting of such appliances relies on a mechanically driven pressure difference. The size of air supply opening is therefore less than that required for appliances with draft control devices. Since the pressure difference developed across the structure or enclosure is significantly greater than that developed under natural buoyancy forces, air supply openings may be located

anywhere, provided they do not interfere with the performance of the ventilation air opening(s). The primary form of interference to be avoided involves the short-circuiting of air flow that may occur when ventilation and air supply openings are placed near to one another at the same level or on opposite walls at building corners where they are susceptible to wind suction effects.

7.4.4 When air is provided by natural air flow from outdoors into a location containing both types of **equipment** described in Clauses 7.4.2 and 7.4.3, the cross-sectional area of the opening(s) shall not be less than the total required cross-sectional area for both types of **equipment** when calculated in accordance with either Clauses 7.4.2, or 7.4.3, as applicable. This **air supply** opening(s) requirement shall be in addition to the air opening for **ventilation** required in Clause 7.4.1. See also Clauses 3.1.4 and 3.1.5.

Intent and Rationale — Clause 7.4.4

Clause 7.4.4 is intended to provide air supply requirements for installations containing appliances with and without draft control devices.

When appliances with and without draft control devices are installed, air supply requirements must be calculated separately for the applicable appliance(s). The cross-sectional area for each type of appliance may be provided using either a single opening, or separate openings corresponding to each of the appliances. Single openings must conform with the requirements for opening location under Clause 7.4.2.

7.4.5 When an **air supply** duct is used to meet the requirements of either Clause 7.4.2 or 7.4.3, its discharge opening shall be located where there is no possibility of cold air affecting steam or water pipes and electrical or mechanical **equipment**.

Intent and Rationale — Clause 7.4.5

This Clause is intended to prevent adverse effects arising from the introduction of cold air into the space where the appliances are located.

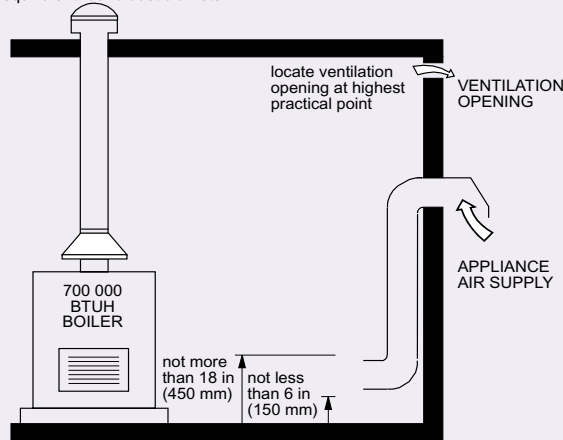
When a duct is used to deliver the outside air supply, it must be located so as to avoid any problems resulting from cold air contacting piping, electrical, or mechanical equipment. The duct itself should also be suitably insulated and provided with a vapour barrier to avoid condensation on the duct surface.

EXAMPLES OF AIR SUPPLY TO APPLIANCES EXCEEDING 400 000 BTUH

EXAMPLE 4A

APPLIANCE WITH DRAFT CONTROL DEVICE

From Clause 7.4.2, for a 700 000 BTUH input, the required free area = $700\,000/7\,000 = 100\text{ in}^2$
 Approximate equivalent round duct diameter = 12 in
 According to Clause 7.4.1, a ventilation opening no less than 10% of that calculated under Clause 7.4.2 is required, or a minimum of 10 in^2
 $100 \times .10 = 10\text{ in}^2$
 Approximate equivalent round duct diameter = 4 in



Clause 7.4 of the B149.1 Code requires that ventilation air and combustion/dilution air are always provided to appliances having inputs exceeding 400 000 Btuh (120 kW).

For appliances having draft control devices, the requirements of Clauses 7.4.1 and 7.4.2 must be applied (Example 4A). The outside air supply must be delivered close to the floor to assist the buoyancy venting of these appliances. The ventilation air opening must be located as high as practicable so that when the appliances are not firing, natural convection acting between the lower air supply opening and the higher ventilation opening will ventilate the space, removing residual heat.

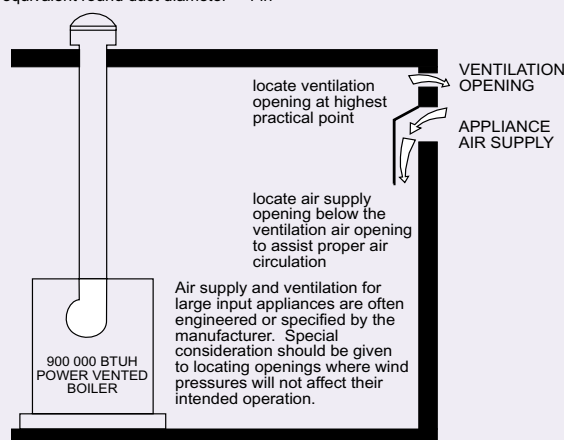
For appliances having power burners without draft control devices, the requirements of Clauses 7.4.1 and 7.4.3 must be applied (Example 4B). Because the venting is not dependent on buoyancy, the only requirement for the location of the air supply opening is that it does not interfere with the operation of the ventilation opening. Practically, this means that the air supply opening should be lower than the ventilation opening.

When both types of appliances are installed, ventilation and air supply openings must be calculated separately and provided according to Clause 7.4.4. Approved engineered design of ventilation and air supply may also be used for any of these installations.

EXAMPLE 4B

APPLIANCE WITHOUT DRAFT CONTROL DEVICE

From Clause 7.4.3, for a 900 000 BTUH input, the required free area = $900\,000/30\,000 = 30\text{ in}^2$
 Approximate equivalent round duct diameter = 6 in
 According to Clause 7.4.1, a ventilation opening no less than 10% of that calculated under Clause 7.4.3 is required, or a minimum of 10 in^2
 $30 \times .10 = 3\text{ in}^2$ - use minimum 10 in^2 required
 Approximate equivalent round duct diameter = 4 in



7.5 Air Supply Dampers, Louvres, and Grilles

Intent and Rationale — Clause 7.5

The requirements of Clause 7.5 are intended to ensure that all air supply dampers, louvres, and grilles have an adequate opening area and are not of a type that could lead to situations where the air supply may be closed off while the burner of an appliance is operating.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.


7.6 Conditions Created by Exhaust Fans, Air Supply Fans, Circulating Fans, or Fireplaces

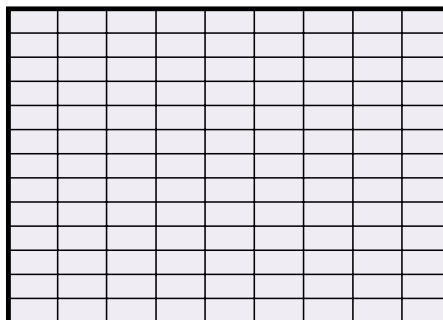
Intent and Rationale — Clause 7.6

The requirements of Clause 7.6 are intended to ensure that the proper performance of any gas appliance is not impaired by the operation of any other appliances or equipment.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.

AIR SUPPLY OPENING REQUIREMENTS

No aperture
dimension
smaller than
0.25 in — 
(6 mm)



Air Supply Opening

Free Area = Gross Area - Blockage Area of Louvres, Grilles, or Screens

NOTE:

Manually operated dampers or manually adjustable louvres are not permitted on the air supply. Only certified automatic dampers or louvres, which are interlocked so the burner cannot operate unless the damper or louver is in the fully open position, are permitted.

7.7 Engineered Installations

Intent and Rationale — Clause 7.7

Clause 7.7 is intended to permit an alternative design of outdoor air supply that uses good engineering design practice approved by the authority having jurisdiction.

The rationale for this requirement is conveyed within the requirement itself.

7.8 Air Supply by Mechanical Means

Intent and Rationale — Clause 7.8

The requirements of Clause 7.8 are intended to permit mechanical air supply, provided that the appliance(s) can only operate when the mechanical supply is functioning.

The rationale for these requirements is conveyed within the requirements themselves.

7.9 Appliance Venting

Intent and Rationale — Clause 7.9

The requirements of Clause 7.9 are intended to identify those appliance that must be connected to an effective chimney or vent and to locate these appliances as close as practicable to the point of vent connection to aid in effective venting.

Unless the appliance is specifically certified for use without a vent or is provided with an acceptable, alternative means for safe disposal of the products of combustion, it must be connected to an effective chimney or vent. For example, a residential-type range is approved for use without a vent. The case of a gas log or fireplace insert, installed in a masonry fireplace with a permanently opened flue, is viewed as providing an approved venting alternative. Direct vent appliances also represent an approved alternative method of venting. Engineering design acceptable to the authority having jurisdiction may also be permitted.

However, all vented appliances must be located as close as practicable to either a chimney or vent, since long vent connectors impair venting.

7.10 Methods of Venting Appliances

Intent and Rationale — Clause 7.10

The requirements of Clause 7.10 are intended to ensure that all chimneys or vents are safe and effective. Chimneys must be suitable for their application, and appliances bearing a special venting system label must be vented accordingly. Vent types are restricted to their approved application(s), and, in general, vents and vent connectors must not be installed in ducts or shafts used for the transport of air.

Venting methods have evolved according to the safety and performance requirements of the appliances they serve. Any method must prove effective in removing all flue gases to the outdoors. Chimneys have restricted applications due to their performance characteristics, which are generally less predictable than the performance of vents specifically designed and approved for use with gas appliances.

Appliances requiring special venting systems must be appropriately labelled to indicate the approved method of venting. Where a Type BH Class II special venting system is specified, the temperature rating marked on the vent materials must be compatible with the flue gas temperature of the appliance being served. Draft control devices used with special venting systems must not be located where positive vent pressures may occur, since this will impair their performance. Further, appliances using a special venting system operating with positive vent pressure must not be connected to the venting system of any other appliance or fireplace, as this may cause the products of combustion from the special venting system to spill through the venting system of the other appliance(s). In all cases, the joints of special

venting systems must be sealed in accordance with the manufacturer's installation instructions to ensure proper performance. In addition, a special venting system must not pass through unheated space or the outdoors unless insulated according to the appliance and vent manufacturer's instructions. This requirement is in response to the methods of testing and approving appliances requiring special venting systems. Non-special vent types, such as Type B, Type BW, and Type L, have restricted applications based on their physical characteristics and approved application.

Irrespective of the type of venting system installed, it must not be located in ducts or shafts transporting air. This requirement reflects the possibility of leakage in the venting system causing contamination of the air serving a building.



Looking Ahead

Refer to Vent Connector
Installation Requirements on
page 169.

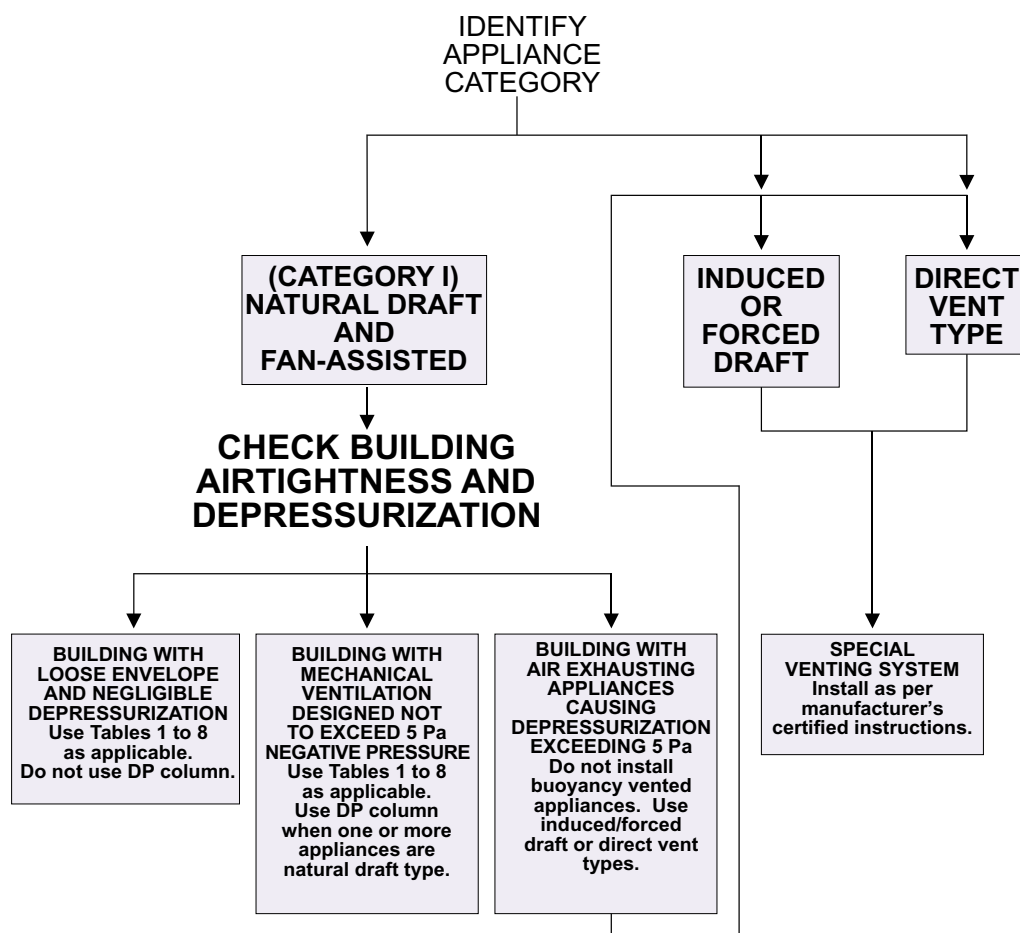
7.11 Vent and Chimney Requirements

7.11 A *Type B, BH, BW, or L vent* or a *factory-built chimney* used for venting an *appliance* shall be *certified*.

Intent and Rationale — Clause 7.11

Clause 7.11 is intended to ensure safety and performance by requiring that all vents and factory-built chimneys used for venting gas appliances be certified to the applicable standards.

The rationale for these requirements is conveyed within the requirements themselves.

VENTING METHODS

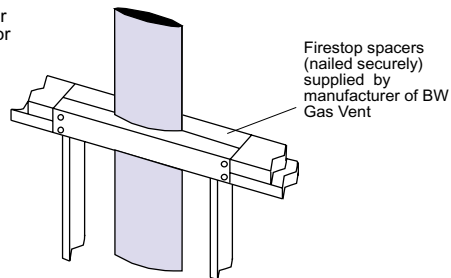
Changes in gas appliance technology, as well as tighter buildings, have changed allowable venting methods and vent sizing. Appendix C of the B149.1 Code was introduced to account for fan-assisted appliance venting, and natural draft appliances installed in buildings where negative pressures up to 5 Pa may be caused by air exhausting equipment. Fan-assisted appliances require proper vent sizing to prevent excessive condensation in the vent, which may lead to corrosion. Both natural draft and fan-assisted appliances (Category I appliances) are spillage susceptible at the 5 Pa negative pressure threshold and should not be installed in buildings where air exhausting equipment causes more than this threshold of depressurization.

Category I appliances may have their venting sized using one of two methods. The first is based on the rules-of-thumb found in Clause 7.13.1 (a) for single appliances and Clause 7.13.2 (a) when a vent serves more than one appliance (see CSA Standard B149.1-00). The second method involves using the applicable data found in Tables C.1 to C.8 of Appendix C. Induced or forced draft and direct vent appliances require special venting systems that must be installed according to the manufacturer's certified installation instructions. The chart above may be used to determine the appropriate method of venting, and the applicable sizing tables to be used for appliance venting.

TYPE BW VENTING REQUIREMENTS

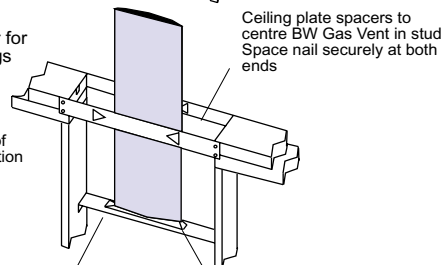
Installation of BW Gas Vent for each subsequent ceiling or floor level of multistorey buildings

Plate cut away to provide passage of BW Gas Vent



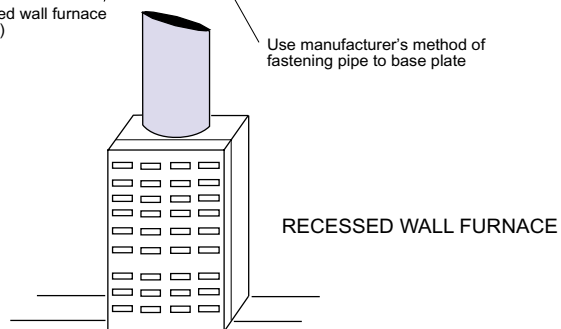
Installation of BW Gas vent for one storey buildings or for first floor of multistorey buildings

Plate cut away for full width of stud space to provide ventilation



Header plate of vented wall furnace (also acts as firestop)
Sheet metal screw base plate to header

Use manufacturer's method of fastening pipe to base plate



Adapted from *National Fuel Gas Code Handbook*, 1992

Certified Gas Vent Types

Gas appliances may be vented to either a chimney flue or a certified vent or factory-built chimney. When vents are used, they must be certified to the applicable standard and bear a label that indicates that they have been so tested and approved. It is important not to remove these labels in order to enable field inspection. In the case of Type B or Type L vents, each length extending above the roof line must be certified for exterior use and so identified. The discussion appearing below is intended to summarize the characteristics and suitability of certified gas vents.

Type B Vents

Type B vents are constructed of noncombustible, corrosion-resistant material and generally employ double wall construction enclosing an insulating air space. Type B vents are normally intended for gas appliances certified with draft hoods or diverters; however, they may also be used for appliances without draft control devices provided:

- (a) the appliance is certified for use with a Type B vent;
- (b) the flue gas temperatures normally exceed 275 °F (135 °C), but do not exceed 464 °F (240 °C);
- (c) the vent normally operates below atmospheric pressure; and
- (d) condensation of flue gas products is not normally expected within the vent.

Type B vents must be certified under ULC Standard CAN/ULC-S605-1991, *Gas Vents*, and the requirements of this standard also apply to spacers, supports, firestop spacers, draft hood connectors, caps, and roof assemblies.

Type BW Vents

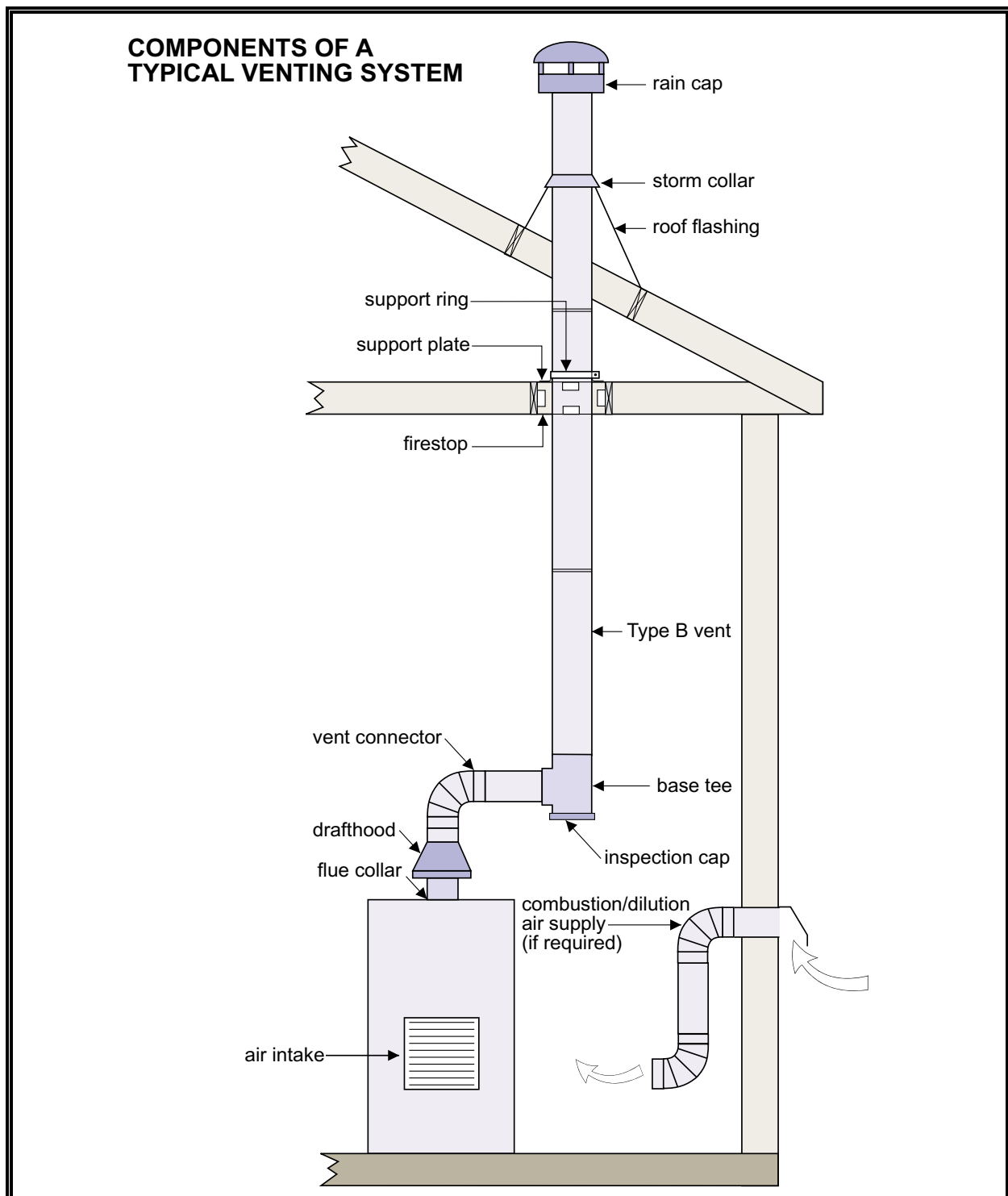
Type BW vents are of similar construction to Type B vents but are oval in cross-section. They are designed specifically for installation in walls for venting recessed wall furnaces. Type BW vents must be certified under ULC Standard CAN/ULC-S605-1991, *Gas Vents*, and the requirements of this Standard apply to all components of the venting system. Due to the development of side-wall vented appliances, the use of Type BW vents is not common.

Type L Vents

Type L vents are capable of withstanding a flue gas temperature of 572 °F (300 °C) (higher than that of Type B vents). They may be used with appliances certified for use with Type L vents and may also be used in place of Type B vents. Type L vents must be certified under ULC Standard S609-1989, *Type L Low Temperature Vents*, and the requirements of this standard apply to all components of the venting system.

Type BH Vents

Type BH vents are intended for the negative or positive pressure venting of gas appliances. Type BH vents are normally part of a special venting system or a certified venting system provided by the appliance manufacturer. Care must be exercised to use the correct class of Type BH venting system. Class I Type BH venting systems are rated for flue gas temperatures between 275 °F (135 °C) and 473 °F (245 °C). Class II Type BH venting systems have 4 categories: A — up to 149 °F (65 °C); B — up to 194 °F (90 °C); C — up to 230 °F (110 °C); and D — up to 275 °F (135 °C). Always check the requirements on the special venting system label when installing Type BH venting systems. Type BH vents must be certified under ULC Standard S636-1995, *Type BH Gas Venting Systems*, and the requirements of this standard apply to joint sealants and all components of the venting system.



High Temperature Plastic Venting

The proper installation of high temperature plastic venting (HTPV) is necessary in order to avoid future problems. Special attention must be paid to the proper cutting of the vent pipe, the preparation of the surfaces before sealing, and the type of adhesive used to form the seal. The system must be installed to accommodate the movement that will occur during normal operation of the appliance. Remember to maintain all recommended clearances from combustibles and always follow manufacturer's instructions carefully.

Appliances that are equipped with HTPV systems must not be common-vented with other appliances. Do not connect the HTPV to a B-vent or a masonry chimney. Appliances burning wood, coal, or oil must not be vented through high temperature plastic. Be aware that manufacturers may have other restrictions on the type of appliances permitted to be vented through HTPV.

Some key points are detailed to help avoid common installation problems and failure of the venting system.

The information presented herein is intended as a reminder to exercise due diligence in the installation of HTPV systems. This is not intended as a substitute for manufacturer's instructions. Always follow these instructions. All HTPV system installations must conform to the requirements of the authority having jurisdiction.

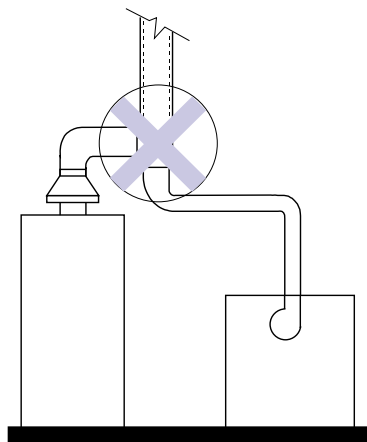
Cutting

Proper cutting of the vent pipe is the first step towards ensuring a problem-free installation. Pipe must be squarely cut. Pipe that is not cut off square may not fit properly into the fitting socket. Use of a miter box, and a fine-tooth saw (24 teeth/in or as required by the manufacturer) is recommended for cutting the pipe. Ensure that cut pipe is smooth and free of burrs.

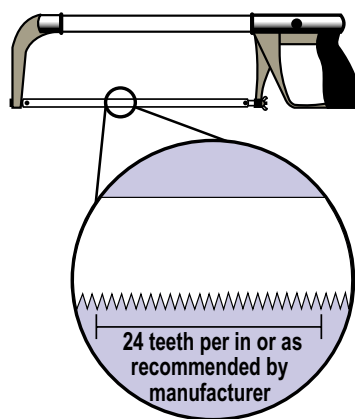
Surface Preparation

All pipe and fittings should be carefully cleaned before applying adhesive. The manufacturer's instructions should specify how much of the pipe to clean. Clean the end of the pipe where it will be inserted into the fitting socket and clean the fitting socket as well. Don't touch prepared surfaces after cleaning. The type of cleaning solvent to be used should be specified by the manufacturer. Always carefully follow the manufacturer's specifications.

Do NOT Common Vent



Use Proper Tools



Joining Pipe and Fitting

Manufacturer's instructions should indicate how vent pipe is to be fitted together. Carefully review and follow these instructions. Proper installation is essential to creating a good joint.

Adhesive Curing

All joints in the high temperature plastic vent must be sealed with the proper adhesive to prevent leakage of flue gases into the living space. Do not drill or punch holes in the plastic pipe or fittings. Some manufacturers may permit the use of pressure-sensitive foil tape to secure joints during the adhesive curing time. The tape, however, must not be used as a substitute for the adhesive. Check with the vent manufacturer if in doubt.

Adhesives used to seal HTPV must be certified for use with the vent.

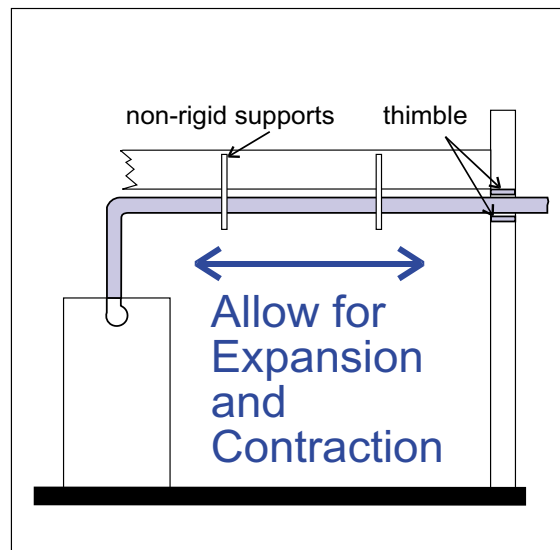
Note carefully the curing characteristics of the adhesive. Note the time that the joint requires to properly cure. No joint movement should occur during this period. Follow manufacturer's instructions carefully as they relate to the effect of both hot and cold temperatures on the joint adhesive. Note if the manufacturer recommends any special procedures for joining pipe under extremely cold conditions. Also, note when the furnace should be operated for the first time after the adhesive has begun to cure and whether the furnace may be operated to accelerate curing.

Applying the right adhesive and allowing it to cure properly are important steps to avoiding failure.



Support

Plastic piping will expand and contract as it experiences variations in temperature. The venting system, pipe, and fittings must be allowed to move in response to the thermal expansion and contraction from the temperature cycle. Do not constrain the plastic pipe with clamps or straps. Improper connection of the vent to the flue collar of the appliance may result in cracking of the vent. Do not rigidly anchor the plastic pipe particularly where the pipe penetrates a wall. Use the manufacturer's certified wall thimble for all wall penetrations. Restricting vent movement through the wall is a primary cause of vent problems. Minimizing thermal and mechanical stresses in the vent system is essential to the long-term durability of the system. Always avoid sags when installing the system.



Air Space Clearances

Minimum air space clearances to combustible materials must be maintained around high temperature plastic vent pipe. Do not wrap insulation around the plastic pipe.

Manufacturer's certified instructions should always be followed when installing these types of systems.

7.12 Chimneys

7.12.1 A *masonry, concrete, or metal chimney* shall be built and installed either in accordance with the local building code or, in the absence of such, in accordance with the *National Building Code of Canada*.

- Δ **7.12.2** Before replacing an existing *appliance* or connecting a *vent connector* to a chimney, the chimney flue shall be examined to ascertain that the chimney
- (a) is properly constructed;
 - (b) is lined with a tile or metal liner;
 - (c) is clear and free of soot, creosote, or obstructions;
 - (d) will effectively conduct the products of combustion outdoors; and
 - (e) is sized in accordance with Clause 7.13.

7.12.3 An *appliance* installed in a dwelling unit shall not be connected to a *flue* serving

- (a) a solid-fuelled *appliance*; or
- (b) a solid-fuelled *fireplace* unless the opening from the *fireplace* to the *flue* is permanently closed.

Intent and Rationale — Clauses 7.12.1 to 7.12.3

Clauses 7.12.1 to 7.12.3 are intended to ensure that chimneys conform to applicable building code requirements, provide effective venting, and, in dwelling units, do not also serve a solid-fuelled appliance or active fireplace.

Chimneys must be constructed to meet building code requirements for fire safety and structural integrity. For new chimneys, the requirements under the applicable building code must be met by the builder. The installer, 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. Cleaning and/or repair of the chimney, if required, must therefore be carried out prior to connection. 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), it must not be used to vent a gas-burning appliance. This requirement is based on the risk of soot and creosote build-up in chimney flues serving solid-fuelled appliances, which may adversely affect venting and pose a potential fire hazard. Together, these Clauses serve as general requirements for chimney venting.

Intent and Rationale — Clauses 7.12.4 to 7.12.10

The requirements of these Clauses are intended to prescribe the connection of gas appliance vents to shared chimney flues and the provision of clean-outs for chimneys. The requirements are also intended to prescribe the lining characteristics and size limitations of chimneys serving gas appliances, including suitable measures for the rectification of deficient chimneys.

The rationale for these requirements is conveyed within the requirements themselves.

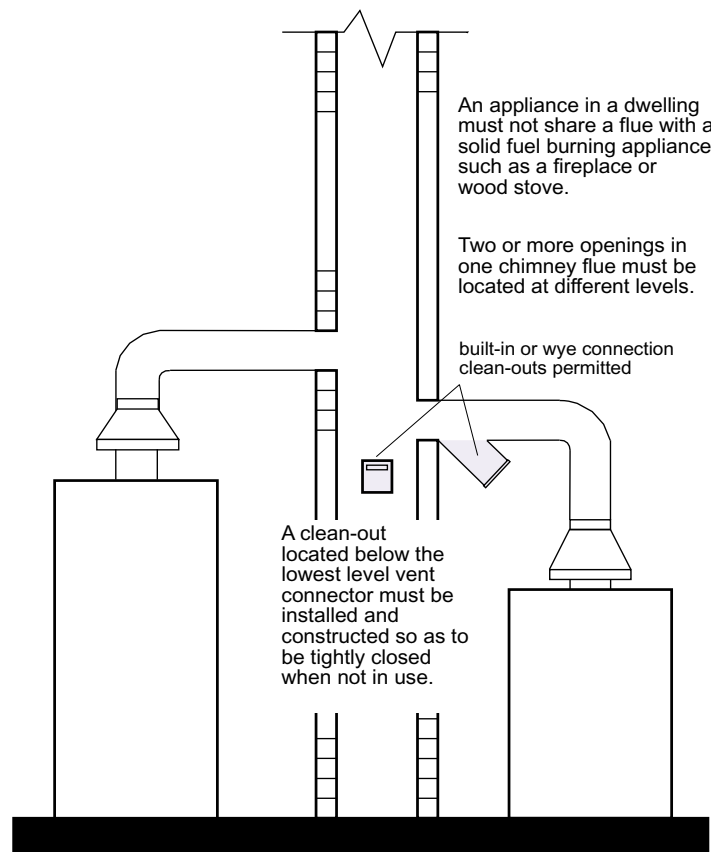
7.12.11 The venting of a gas-fired space-heating *appliance* into a *chimney flue* common to both halves of a semi-detached house is prohibited.

Intent and Rationale — Clause 7.12.11

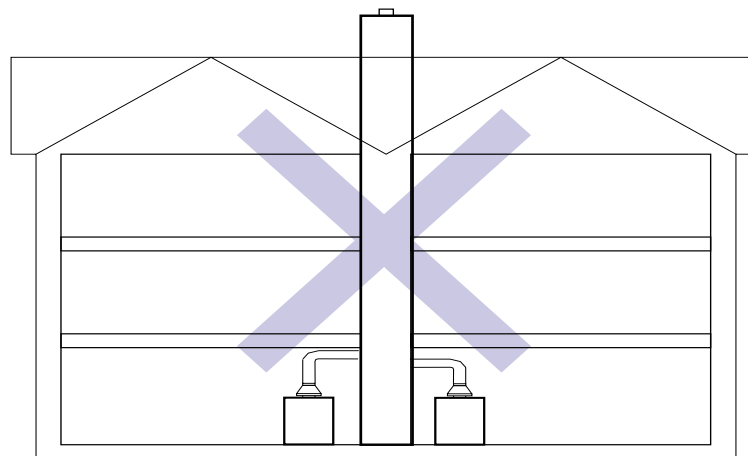
The requirements of this Clause are intended to generally prohibit connections to chimney flues common to both halves of a semi-detached house.

This requirement is intended to avoid situations where operation of an appliance in one dwelling unit may result in spillage of flue gases into the adjacent dwelling unit. This requirement is important to observe when performing conversions to gas in older semi-detached dwellings.

CHIMNEY VENTING REQUIREMENTS



PROHIBITED SEMI-DETACHED CHIMNEY VENTING

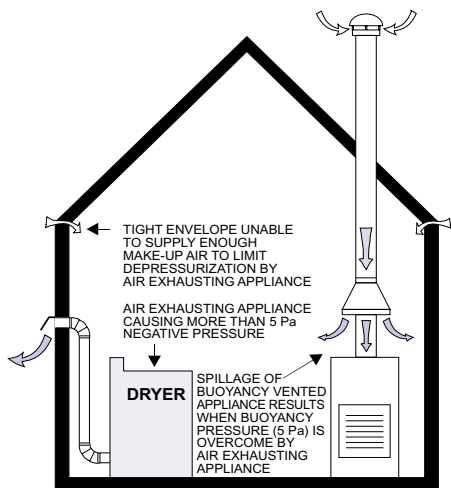


NOT PERMITTED

Venting of a gas-fired space heating appliance into a chimney flue common to both halves of a semi-detached house is prohibited.

VENTING AND SPILLAGE SUSCEPTIBLE APPLIANCES

COMBUSTION APPLIANCE SPILLAGE



Current building code requirements for the control of building pressures and combustion appliance spillage make gas appliance venting and spillage susceptibility important factors to consider when specifying gas appliances.

The spillage of combustion products occurs when a spillage susceptible appliance is subjected to a sustained negative pressure greater than the buoyancy venting pressure it is able to establish during its operation. While the phenomenon of spillage is easy to understand, spillage susceptibility is a little more complicated.

Spillage susceptibility involves both the venting characteristics of the appliance and the method of venting. Non-spillage susceptible appliances are power vented to a gas-tight venting system, making them resistant to spillage at relatively high negative building pressures. Appliances are considered spillage susceptible if either the venting is driven by buoyancy or the venting system is not gas-tight. The currently established threshold of negative pressure which an appliance must withstand to be considered non-spillage susceptible is 5 Pa. This is based on the typical buoyancy venting pressure developed by natural draft and fan-assisted 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 when they become available. Type B, BW, and L vents that are not gas-tight are also considered spillage susceptible.

Induced or forced draft gas appliances (Categories III & IV) are not considered spillage susceptible when connected to a gas-tight venting system, for example, a type BH venting system with sealed joints. Direct vent appliances (in any Category I to IV), due to their sealed method of air supply and venting, are also considered non-spillage susceptible.

In practical terms, Category I natural draft or fan-assisted gas appliances should not be installed in buildings that experience greater than 5 Pa negative pressure. Appliances connected to Type B, BW, or L venting systems also should not be installed in buildings exceeding the 5 Pa negative pressure threshold. Refer ahead to the **Venting Methods Chart** to determine the suitability of appliances and venting methods.

BASIC CONSIDERATIONS

When specifying gas appliances for any proposed installation, the following items should be carefully considered:

- Does or will the building contain air exhausting appliances without the provision of make-up air?
- Is the building of recent construction, and does it appear to have a tight building envelope?

If the answer to both of these questions is **YES**, then spillage susceptible appliances should be avoided.

Spillage susceptible appliances may still be installed; however, suitable provisions for make-up air must be made if the appliances are to operate and vent properly.

SPILLAGE SUSCEPTIBLE APPLIANCES

Natural draft and fan-assisted gas appliances (defined as Category I appliances in Appendix C) are considered spillage susceptible and should not be installed in structures or enclosures which may be depressurized beyond 5 Pa pressure. In simple terms, any appliance connected to a venting system complying with the requirements of Appendix C is considered spillage susceptible.

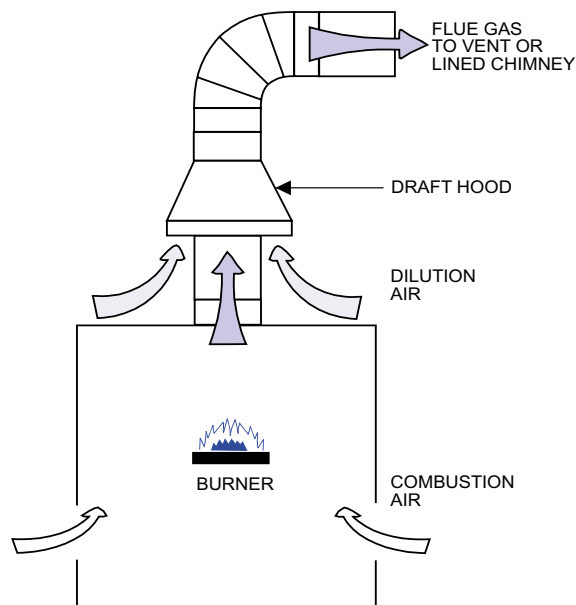
Natural Draft Gas Appliances (Category I)

Natural draft appliances rely on the buoyancy of warm combustion flue gases for venting. In operation, these appliances require both combustion air and dilution air. The combustion air is admitted through the appliance cabinet to the burner. Dilution air is delivered using some type of draft control device, typically a draft hood located downstream of the burner. Natural draft appliances are typically vented using either a Type B vent or a chimney flue.

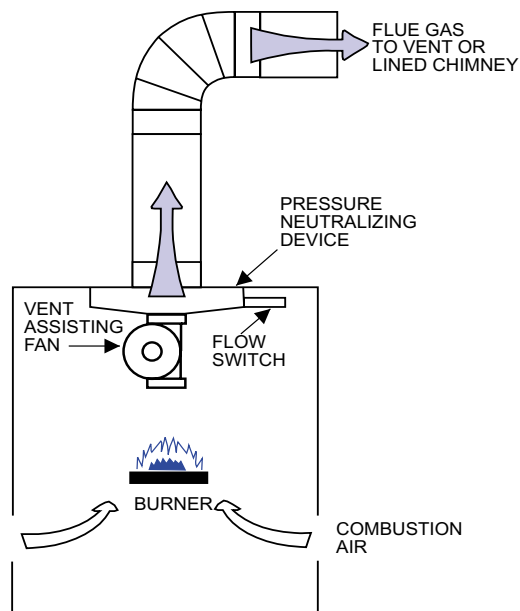
Fan-Assisted Gas Appliances (Category I)

Fan-assisted gas appliances were developed to attain a higher combustion efficiency than natural draft appliances, without requiring a special venting system or means of handling flue gas condensate. This type of appliance is also considered spillage susceptible. A fan regulates combustion air supply in fan-assisted appliances. Unlike forced or induced draft equipment, the fan does not develop any venting pressure. Instead it delivers air at a rate that results in more complete combustion. 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, flue gases are vented by buoyancy forces. A flow switch is incorporated that proves the vent assisting fan is operating. The vent sizing tables in Appendix C were largely developed to provide effective venting of fan-assisted appliances. As the combustion efficiency of gas appliances increases, the flue gas temperature decreases. In an overly large vent, the amount of heat in the flue gases may not be sufficient to prevent condensation of the gases, thereby leading to corrosion problems. The new tables allow for the proper sizing of vents to avoid this problem.

NATURAL DRAFT APPLIANCE

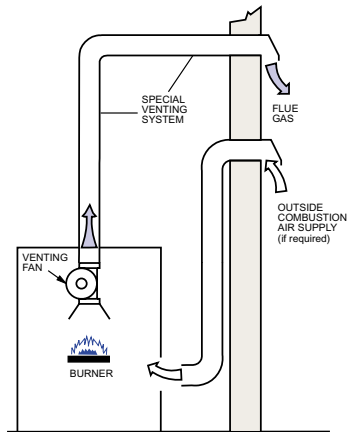


FAN-ASSISTED APPLIANCE

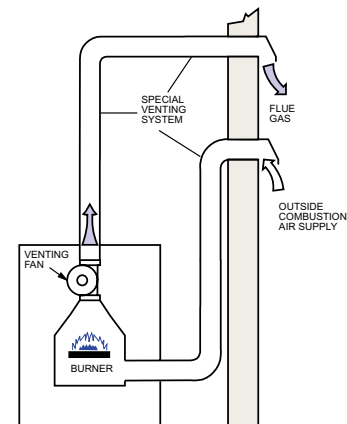


NON-SPILLAGE SUSCEPTIBLE APPLIANCES

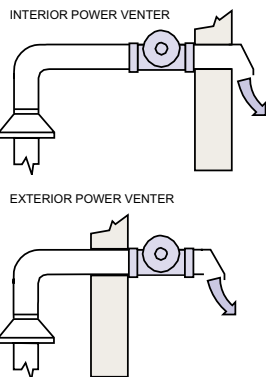
INDUCED OR FORCED DRAFT GAS APPLIANCE



DIRECT VENT GAS APPLIANCE



POWER VENTED GAS APPLIANCES



Induced or forced draft, direct vent, and power vented appliances are considered non-spillage susceptible under the normal range of negative pressures in buildings.

Induced or Forced Draft Appliances

Induced or forced draft appliances are defined as appliances that operate with a positive vent static pressure. Because induced or forced draft appliances are positively vented, a gas-tight venting system is normally specified by manufacturers. Some manufacturers have certified appliances to be convertible to B-venting and, in such cases, they are considered to be spillage susceptible appliances. The reason for this is that the appliance is no longer positively vented; it is buoyancy vented to a venting system that is not gas-tight. Always check with the authority having jurisdiction regarding the acceptability of these types of appliance venting conversions.

Direct Vent Appliances

Direct vent or sealed combustion appliances are completely gas-tight in relation to the inside of the building. All direct vent appliances use special venting systems specified or supplied by the manufacturer.

Direct vent appliances have the advantage of being completely uncoupled from the environment of the structure or enclosure in which they are located. Unlike induced or forced draft appliances, direct vent appliances can generally tolerate conditions such as dust, corrosive gases, or large negative pressures. In such applications, the venting and air supply systems should be carefully sealed and checked to ensure gas-tight construction.

Power Vented Appliances

Interior or exterior power vented appliances are considered non-spillage susceptible under normal ranges of negative pressures in buildings. Ensure that the appliance is certified for use with a power venter and that the power venter itself is certified for the intended application.

7.13 Vent and Chimney Sizing

Intent and Rationale — Clause 7.13

The requirements of this Clause are intended to provide a basis for vent and chimney sizing for Category I appliances (drafthood-equipped and fan-assisted appliances) and appliances requiring special venting systems.

Requirements for the allowable shape of vents are intended to ensure effective venting.

Vent and chimney sizing for buoyancy vented (drafthood-equipped and fan-assisted appliances) may be based on either accepted rules of thumb or in accordance with good engineering practice. Rules of thumb, as stated in Clauses 7.13.1(a) and 7.13.2(a), are based on acceptable past performance; however, these may prove conservative leading to larger sizes and hence more costly components. Good engineering practice has been translated into a series of tables reproduced in Appendix C at the end of this chapter. The tables are based on research conducted by the Canadian Gas Research Institute. The Canadian Gas Research Institute used this approach to develop venting performance under a 5 Pa negative pressure. Engineered venting tables acceptable to the authority having jurisdiction are also permitted.

Appliances requiring a special venting system having a positive vent pressure may only use a single, dedicated vent that is sized so that its area is not less than that of the appliance flue outlet. For special venting systems certified as a component of the appliance, manufacturer's certified installation requirements must be observed.

In general, a vent may be of any shape provided its venting capacity is equivalent to that of the round pipe for which it is substituted; however, its minimum internal dimension must not be less than 2 in, and in no case can its area be less than that of a 3 in diameter pipe. This requirement is based on the unstable venting behaviour of small aperture vents.

7.14 Vent and Chimney Termination

7.14.1 A *vent* or *chimney* shall extend high enough above either a **building** or a neighbouring obstruction so that wind from any direction will not create a positive pressure in the vicinity of either the *vent* or *chimney* termination.

7.14.2 Except for a **special venting system** with positive *vent* pressure, a *vent* shall extend not less than 2 ft (600 mm) above the highest point where it passes through a flat roof of a **building** and not less than 2 ft (600 mm) higher than any portion of a **building** within a horizontal distance of 10 ft (3 m).

7.14.3 A vent used in a **special venting system** with positive *vent* pressure and passing through a roof shall extend at least 18 in (450 mm) above the highest point where it passes through the roof surface and any other obstruction within a horizontal distance of 18 in (450 mm).

7.14.4 A *chimney* shall extend not less than 3 ft (900 mm) above the highest point where it passes through the roof of a **building** and not less than 2 ft (600 mm) higher than any portion of a **building** within a horizontal distance of 10 ft (3 m).

7.14.5 Except for a **special venting system** with positive *vent* pressure, a *vent* passing through a pitched roof shall extend above the highest point where it passes through a roof surface in accordance with Figure 7.14.5 and not less than 2 ft (600 mm) above any other obstruction within a horizontal distance of 10 ft (3 m).

7.14.6 A *vent* or *chimney* shall extend not less than 5 ft (1.5 m) in height above either the highest connected **appliance draft hood** outlet or **flue** collar except as provided in Clause 7.24.1.

7.14.7 A *vent* serving a wall **furnace** shall extend not less than 12 ft (3.6 m) in height above the bottom of the **furnace** and shall contain neither lateral nor horizontal sections unless the **furnace** is **certified** for room **heater**-type venting and is so marked.

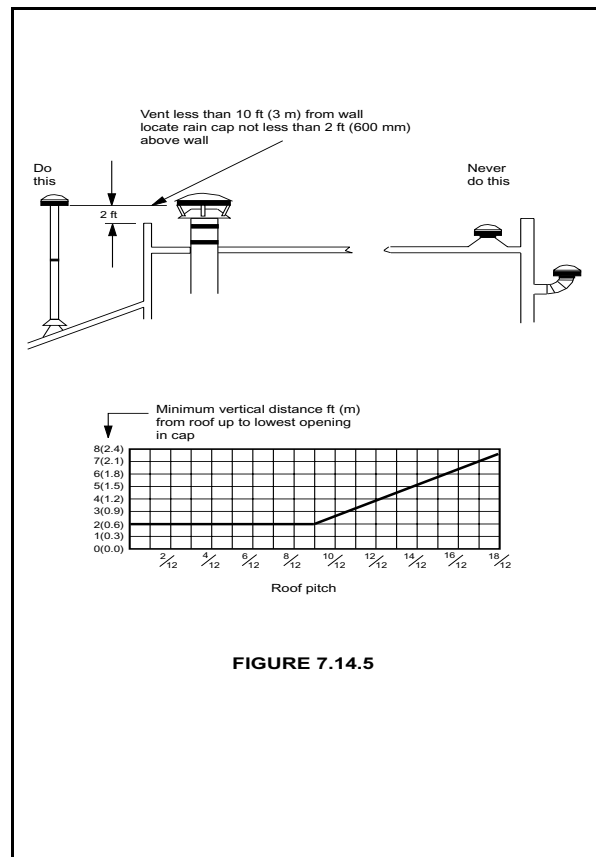
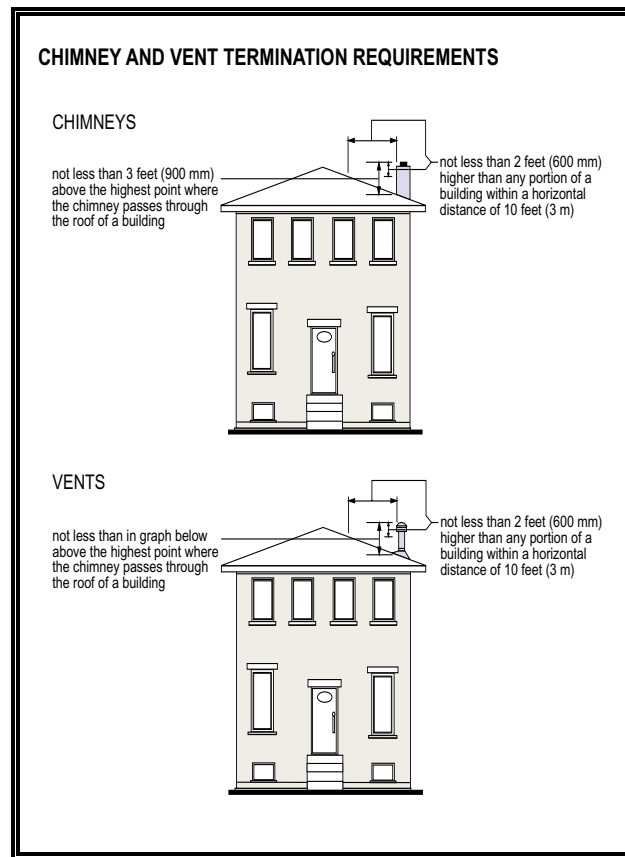


FIGURE 7.14.5

Intent and Rationale — Clauses 7.14.1 to 7.14.7

These Clauses are intended to prescribe the location of vent and chimney terminations and the minimum height for vents serving wall furnaces to ensure effective buoyancy venting. When vents and chimneys terminate in zones of positive wind pressure, venting effectiveness may be severely impaired. In order to avoid this situation, rules of thumb based on acceptable past performance are embodied in the requirements of these Clauses. Based on the requirements of Clause 7.14.1, unusual roof and/or adjacent building configurations may require termination above the minimum heights prescribed herein.

7.14.8 A vent shall not terminate

- (a) directly above a paved sidewalk or paved driveway that is located between two single-family dwellings and serves both dwellings;

- (b) less than 7 ft (2.1 m) above a paved sidewalk or a paved driveway that is located on public property;
- (c) within 6 ft (1.8 m) of a mechanical **air supply** inlet to any **building**;
- Δ (d) above a meter/regulator assembly within 3 ft (900 mm) horizontally of the vertical centre-line of the **regulator** vent outlet to a maximum vertical distance of 15 ft (4.5 m);
- Δ (e) within 3 ft (900 mm) of any gas **service regulator vent** outlet;
- (f) less than 1 ft (300 mm) above grade level;
- (g) within the following distances of a window or door that can be opened in any **building**, of any nonmechanical **air supply** inlet to any **building**, or of the **combustion air** inlet of any other **appliance**:
- Δ (i) 6 in (150 mm) for inputs up to and including 10 000 Btuh (3 kW);
- Δ (ii) 12 in (300 mm) for inputs from 10 000 Btuh (3 kW) up to and including 100 000 Btuh (30 kW); and
- (iii) 3 ft (900 mm) for inputs exceeding

- 100 000 Btuh (30 kW); and
- (h) underneath a veranda, porch, or deck unless
 - (i) the veranda, porch, or deck is fully open on a minimum of two sides beneath the floor; and
 - (ii) the distance between the top of the *vent* termination and the underside of the veranda, porch, or deck is greater than 1 ft (300 mm).

Intent and Rationale — Clause 7.14.8

Clause 7.14.8 is intended to ensure the proper termination of vents, in particular those of the side-wall type, in order to provide effective venting while avoiding air contamination and the impairment of the gas meter and regulator vent performance.

Improper vent termination, particularly in the case of side-wall vented appliances, can lead to a number of problems. The termination of vents above common sidewalks and driveways between two single-family dwellings is not permitted, since flue gases may condense and freeze on paved surfaces or damage adjacent parked vehicles. The 7 ft minimum height of vent terminations above paved sidewalks or driveways on public property is intended to avoid icy surfaces as well as the likelihood of pedestrians bumping their heads on projections.

Vents must not be terminated within 6 ft of mechanical air supply inlets under any circumstances, since the incoming air supply may be contaminated for a sustained period of time. This may prove harmful to building occupants over the long term.

For non-mechanical air inlets, including operable windows and doors, and any combustion air inlets for other appliances, distances from vent terminations are based on the input of the appliance, since this determines the amount of flue gas discharged.

Distances from meter/regulator sets are intended to prevent water vapour in flue gases from condensing on service regulator vent outlets where it may then freeze and plug the outlet.

Due to snow, leaf, and debris accumulation, vents must terminate at least 1 ft above grade level to minimize the risk of plugging. Local installation experience and extreme weather conditions should also be carefully considered.

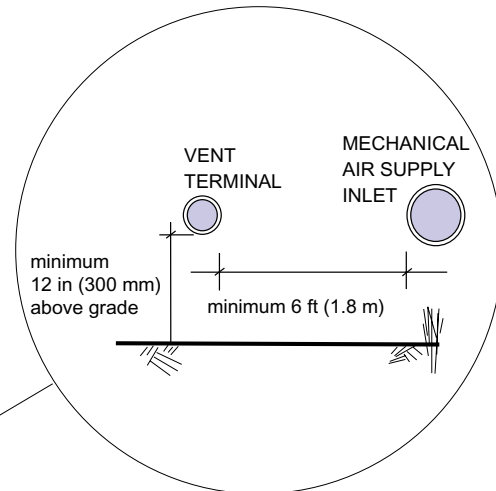
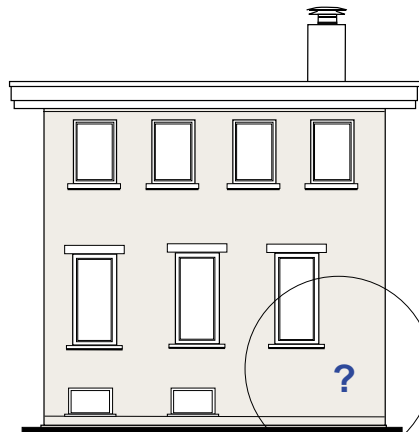
Requirements for vent terminations beneath a veranda, porch, or deck are intended to ensure that outside air can freely circulate to allow for proper venting and sufficient dilution of the flue gases, and to avoid flue gas condensation on the underside of the veranda, porch, or deck.

Intent and Rationale — Clauses 7.14.9 to 7.14.12

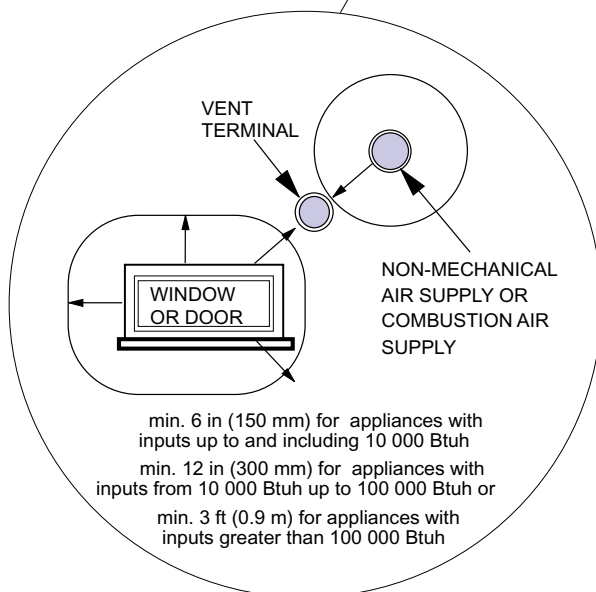
The intent of these Clauses is to provide general installation requirements for vents and their terminations.

The rationale for these requirements is conveyed within the requirements themselves.

SIDE-WALL VENTING REQUIREMENTS

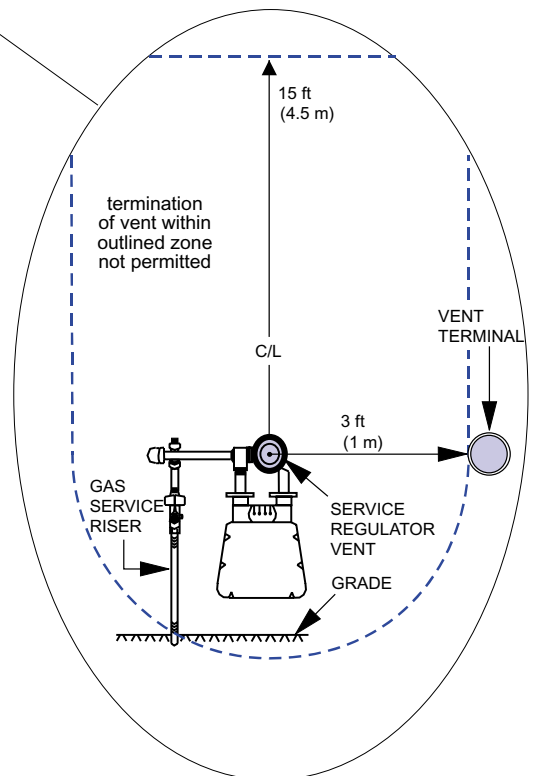


In areas with low street gas pressures, a service regulator may not be installed. Maintain required clearances regardless, since street service may be updated in the future.



A vent is permitted underneath a verandah, porch, or deck only where there are 2 fully open sides beneath the floor. A minimum 12 in (300 mm) must be maintained from the vent to the underside of the verandah, porch, or deck.

The vent must be fitted with a cap in accordance with the vent manufacturer's installation instructions.



7.15 Vent and Chimney Support

Intent and Rationale — Clause 7.15

The requirements of Clause 7.15 are intended to ensure the adequate support of vents and chimneys, and ease of inspection.

The rationale for these requirements is conveyed within the requirements themselves.

The rationale for these requirements is conveyed within the requirements themselves.

7.16 Vents and Chimneys Serving Two or More Appliances

Intent and Rationale — Clause 7.16

Clause 7.16 is intended to deal with the arrangement of vent connectors when two or more enter a common vent or chimney and when two or more appliances are vented through a common vent connector, in order to ensure effective venting.

7.17 Vents outside Buildings

Intent and Rationale — Clause 7.17

The requirements of Clause 7.17 are intended to ensure that vents installed outdoors and forming part of a natural draft venting system are suitable for exterior use, identified as such for inspection purposes, properly installed, and sufficiently insulated.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.

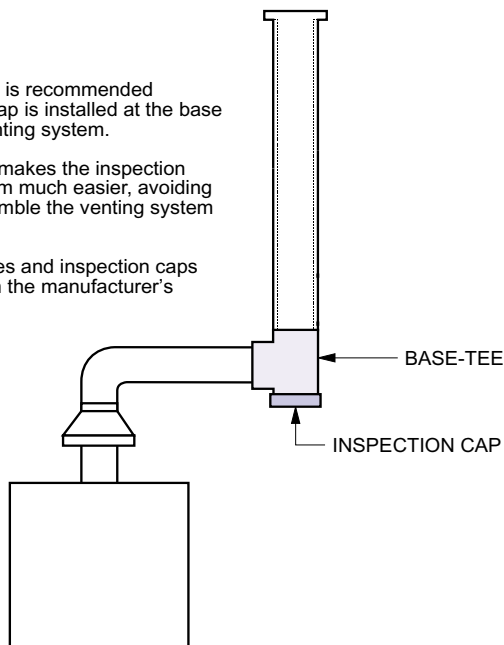
PROVISION OF INSPECTION CAPS



When practicable, it is recommended that an inspection cap is installed at the base of the appliance venting system.

The inspection cap makes the inspection of the venting system much easier, avoiding the need to disassemble the venting system or climb to the roof.

Only install base-tees and inspection caps certified for use with the manufacturer's venting system.



7.18 Vent Connectors

Intent and Rationale — Clause 7.18

The requirements of Clause 7.18 are intended to ensure that vent connectors are constructed from suitable materials, appropriately sized and arranged, provided with adequate clearance to combustible materials, and securely supported.

The rationale for the requirements of this Clause is conveyed within the requirements themselves, with the exception of Clauses 7.18.10 to 7.18.13.

7.18.10 Except as provided in Clause 7.18.13, a **vent connector** of **Type B vent** material shall be installed with a minimum clearance to **combustible** material, including passage through either a **combustible** wall or partition, in accordance with Table 7.18.10.

7.18.11 Except as provided in 7.18.13, the minimum clearance of a **vent connector** of other than **Type B vent** material to a **combustible** wall or partition shall be in accordance with Table 7.18.10.

7.18.12 When a **vent connector** of other than **Type B vent** material passes through either a **combustible** wall or partition, the **combustible** material shall be guarded at the point of passage with either

- (a) a ventilated metal thimble not smaller than the following:
 - (i) for an **appliance**, other than a **floor furnace** and incinerator, the thimble shall be 4 in (100 mm) larger in diameter than the **vent connector**, unless there is not less than 6 ft (1.8 m) of **vent connector** in the open between the **draft hood** and thimble, in which case the thimble may be 2 in (50 mm) larger in diameter than the **vent connector**;
 - (ii) for a **floor furnace**, the thimble shall be 6 in (150 mm) larger in diameter than the **vent connector**; and
 - (iii) for an incinerator, the thimble shall be 12 in (300 mm) larger in diameter than the **vent connector**; or

- (b) **noncombustible** insulation and clearances that will prevent the surface temperature of the **combustible** material from exceeding 194 °F (90 °C).

7.18.13 Except for passage through either a **combustible** wall or partition, the clearance from a **vent connector** to **combustible** material may be reduced when the **combustible** material is protected as specified in Table 7.18.13.

Intent and Rationale — Clauses 7.18.10 to 7.18.13

Clauses 7.18.10 to 7.18.13 are intended to ensure the adequate clearance between vent connectors and combustible materials.

Table 7.18.10 provides minimum clearances between combustible materials and vent connectors based on historic testing and acceptable past performance. The first column of clearances applies to Type B vent connectors, unless otherwise specified, and the second column applies to all other types. When vent connectors other than Type B pass through a combustible wall or partition, either a thimble conforming to the requirements of Clause 7.18.12(a) must be installed or noncombustible insulation and clearances must be provided according to Clause 7.18.12(b). These methods of guarding the point of passage rely on reducing heat transfer to the combustible materials using air circulation and/or noncombustible insulation and represent the only methods currently permitted. Table 7.18.13 permits the reduction of vent connector clearances to combustible materials when specified forms of protection are used. These reductions may not be applied to that portion of a vent connector passing through a combustible wall or partition. Note that the table provides the *distance clearances may be reduced by*, not the *distance clearances may be reduced to*.

VENT CONNECTORS PENETRATING COMBUSTIBLES

Floor Furnace

Thimble diameter must be at least 6 in (150 mm) larger than vent diameter

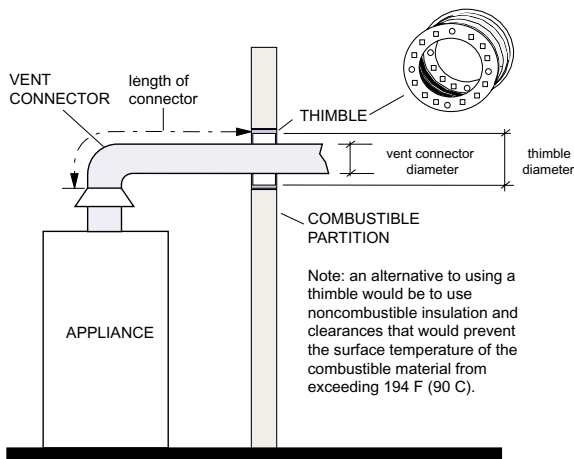
Incinerator

Thimble diameter must be at least 12 in (300 mm) larger than vent diameter

Other Appliances

For a vent connector less than 6 ft long: Thimble diameter must be at least 4 in (100 mm) greater than the vent diameter

For a vent connector 6 ft long or more: Thimble diameter must be at least 2 in (50 mm) greater than the vent diameter



VENT CONNECTOR INSTALLATION REQUIREMENTS

The vent connector should be installed with as few turns and bends as possible. It must be installed with no dips or sags.

A single wall vent connector must not pass through a wall or a ceiling.

NOTE: A clothes dryer moisture exhaust is not considered a vent connector.

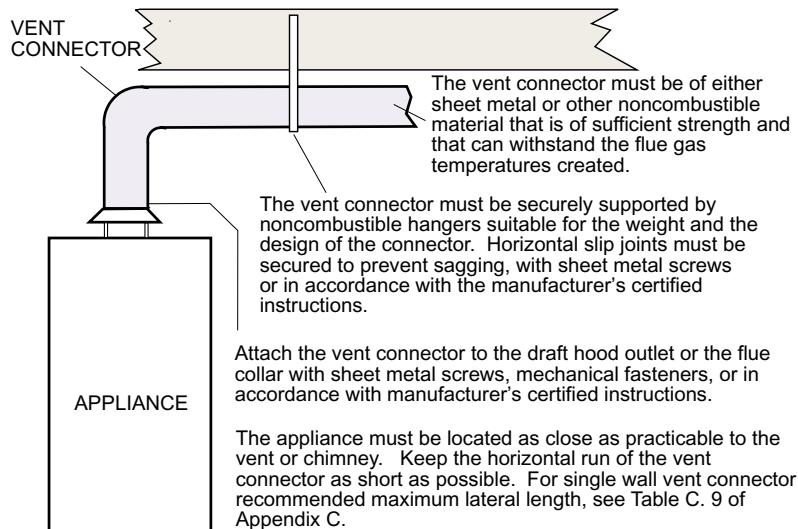


Table 7.18.10
Appliance Vent Connector Clearances

Appliance connector	Minimum distance from combustible material in (mm)	
	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)
Incinerator	Not permitted	18 (450)
Conversion burner (with draft hood)	6 (150)	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).

Table 7.18.13
Vent Connector Clearance Reductions
with Specified Forms of Protection

Type of protection	Where the required clearance with no protection is		
	6 in (150 mm)	9 in (225 mm)	18 in (450 mm)
0.25 inch (6 mm) <i>insulating millboard</i> spaced out 1 in (25 mm) with <i>noncombustible</i> spacers	3 (75)	3 (75)	6 (150)
No. 28 MSG (0.30 mm) metal on 0.25 in (6 mm) <i>insulating millboard</i>	4 (100)	5 (125)	6 (150)
No. 28 MSG (0.30 mm) metal spaced out 1 in (25 mm) with <i>noncombustible</i> spacers	4 (100)	5 (125)	9 (225)

7.19 Chimney Connections

Intent and Rationale — Clause 7.19

The requirements of Clause 7.19 are intended to ensure the proper connection of vent connectors to chimneys in order to permit clean-out of the chimney and the vent connector(s).

Requirements are also intended to prevent any obstruction of the chimney flue by the vent connector and to adequately seal the space between the chimney and the chimney liner to prevent the leakage of flue gases and the entry of moisture and debris. A proper seal also provides an insulating air space, thereby improving venting while reducing condensation.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.

7.20 Size and Height of Interconnected Vent Connectors

Intent and Rationale — Clause 7.20

The requirements of Clause 7.20 are intended to ensure the proper sizing and connection height of interconnected vent connectors in order to provide effective venting and adequate clearances to combustible materials.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.

7.21 Multi-storey Venting

Intent and Rationale — Clause 7.21

The requirements of Clause 7.21 are intended to ensure the effective venting of multi-storey venting systems.

The rationale for the requirements of this Clause is conveyed within the requirements themselves. See Figures C.12 and C.13 of Appendix C at the end of this chapter for further explanation.

7.22 Dampers and Attachments

Intent and Rationale — Clause 7.22

The requirements of Clause 7.22 are intended to prohibit the use of any dampers or attachments that may impair venting performance and safety.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.

7.23 Draft Hoods

Intent and Rationale — Clause 7.23

The requirements of Clause 7.23 are intended to ensure the provision of draft hoods for applicable appliances, and to determine their size, arrangement, and location.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.

Notes on Appendix F

Appendix F was developed to provide information to installers regarding suggested draft hood dimensions for various flue opening sizes. The tables in Appendix F are intended to be used to properly select and size draft hoods when an existing appliance is converted. Inspection authorities may also refer to these figures and tables when reviewing installations to determine the appropriateness of the draft hood.

The tables are not specifically intended for manufacturers of draft hoods. Manufacturers should refer to CGA Standard CAN1-6.2-M81, *Draft Hoods*, for information related to the design and testing requirements for draft hoods.

Ensure that the appliance manufacturer's supplied or recommended draft hood is installed with the venting system (this does not apply to conversions).

7.24 Venting Arrangements

Intent and Rationale — Clause 7.24

Clause 7.24 is intended to provide general requirements for venting arrangements including power-type vent and chimney exhausters, connections between natural draft and special venting systems, the use of exhaust hoods or canopies, and the sizing of venting systems.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.

7.25 Draft Regulators

Intent and Rationale — Clause 7.25

Clause 7.25 is intended to provide general requirements for draft regulators and specific requirements that apply to incinerators but not to other types of appliances served by draft regulators.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.

7.26 Automatic Vent Damper or Automatic Flue Damper

Intent and Rationale — Clause 7.26

Clause 7.26 is intended to restrict the type and connection of automatic vent dampers and flue dampers.

The rationale for the requirements of this Clause is conveyed and referenced within the requirements themselves.

7.27 Manually Operated Flue Dampers

Intent and Rationale — Clause 7.27

The requirements of Clause 7.27 are intended to restrict the unsafe installation of manually operated flue dampers and provide specific safety measures for installations that are permitted.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.

7.28 Installation of Draft Control Devices

Intent and Rationale — Clause 7.28

Clause 7.28 is intended to ensure that all draft control devices are installed according to manufacturer's installation instructions and in the manner in which they have been designed to operate effectively.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.

7.29 Induced or Forced Draft Devices

Intent and Rationale — Clause 7.29

The requirements of Clause 7.29 are intended to provide general safety requirements for all induced or forced draft devices and to restrict the installation of certified, induced draft, add-on devices for water heaters to water heaters having an input of 50 000 Btuh or less.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.

7.30 Venting of Appliances into Canopies

Intent and Rationale — Clause 7.30

Clause 7.30 is intended to provide requirements for the venting of appliances into canopies.

The rationale for the requirements of this Clause is conveyed and referenced within the requirements themselves.

7.31 Heat Reclaimers

Intent and Rationale — Clause 7.31

Clause 7.31 is intended to restrict the installation of heat reclaimers in the venting systems of gas appliances.

The rationale for the requirements of this Clause is conveyed within the requirements themselves.

Background to Vent Sizing Tables

Prior to 1992, the vent sizing tables appearing in natural gas and propane appliance installation codes only had to deal with natural draft (draft-hood-equipped) appliances. During the late 1980s, minimum efficiency ratings for appliances were imposed by government, which led to the development of the fan-assisted appliance. This type of appliance met the new minimum efficiency ratings by eliminating dilution air through the use of a vent assisting fan. Because fan-assisted appliances still relied on buoyancy venting, a new set of vent sizing tables had to be developed by the gas industry.

During the same period, the building code introduced requirements to limit house depressurization to 5 Pa, the threshold for buoyancy vented appliance spillage. Traditionally, houses were leaky and contained few major air exhausting appliances; as a result, buoyancy vented appliances operated in an environment at or near atmospheric pressure.

In developing the tables, researchers used appliance and venting system configurations that were representative of typical situations. A set of base conditions was also used to generate the tables. These typical configurations and base conditions form the General Venting Requirements in Appendix C, which provide information needed to deal with situations and conditions that deviate from those used to derive the vent sizing tables.

The current version of the vent sizing tables is more complicated than earlier versions because of the new factors that had to be taken into account. The logic behind the tables has not changed, and this handbook is intended to assist designers, installers, and inspectors in applying the new tables and accompanying requirements correctly.

The next section provides a commentary on the general venting requirements governing the vent sizing tables for Category 1 natural gas and propane appliances in Appendix C of the B149.1 Code.



Looking Back

Refer to **2. Definitions, Abbreviations, and Reference Publications** for terminology related to the vent sizing tables. Commentary and examples follow.

Appendix C — Vent Sizing Tables for Category I Natural Gas and Propane Appliances

General Venting Requirements (GVR)

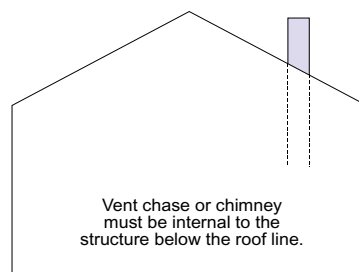
All requirements contained in this Appendix apply to both **Category I** draft hood-equipped and **Category I** fan-assisted combustion **appliances**. At no time shall a **venting system** for a listed **Category II, III, or IV appliance** be sized with these tables. The alternative sizing methods described in the CSA Standard B149 Codes may also be used to size the **venting system** for a draft hood-equipped **appliance**. At this time, alternative sizing methods have not been developed for fan-assisted **appliances**; therefore, until engineering data is developed to allow alternative sizing methods for **Category I** fan-assisted **appliances**, these **vent** tables shall be used.

1. The **vent** tables included in this Appendix 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 may 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 be exposed 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 7.2.1.

When to Use the DP Column

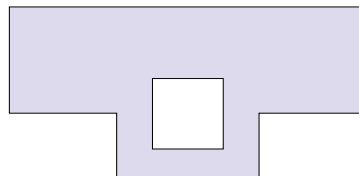
The DP column applies to all buildings that might experience depressurization up to 5 Pa. Practically speaking, use the DP column for all new buildings or any building equipped with air-exhausting appliances. In older, leaky buildings without exhaust equipment, the DP column may be used if the future installation of air-exhausting equipment is reasonably foreseeable.

1. Warm Vents and Chimneys Only



INTERNAL VENT AND CHIMNEY DEFINITION

EXTERNAL CHIMNEY DEFINITION



A chimney with one or more sides exposed to the outside of the structure is considered to be an exterior chimney unless it contains a Type B or certified chimney lining system.

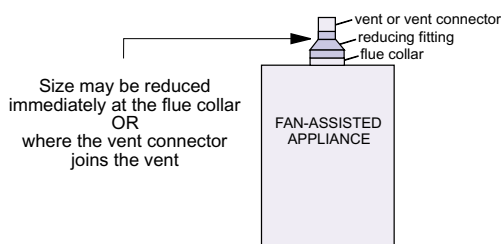
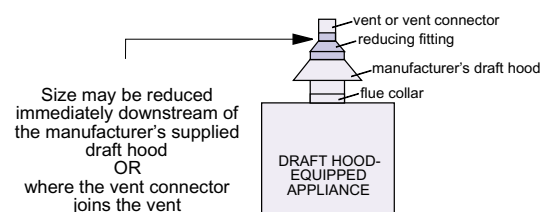
2. If the **vent** or **vent connector** size, determined from the tables, is smaller than the **appliance draft hood** outlet or **flue collar**, the smaller size may be used, provided that

- the total **vent** height (H) is at least 10 ft (3 m);
- vents** or **vent connectors** for **appliance draft hood** outlets or **flue collars** 12 in (305 mm) in diameter or smaller are not reduced more than one table size (eg, 12 in (305 mm) to 10 in (254 mm) is a one-size reduction);
- vents** or **vent connectors** for **appliance draft hood** or **flue collars** above 12 in (305 mm) in diameter are not reduced more than two table sizes (eg, 24 in (607 mm) to 20 in (508 mm) is a two-size reduction);
- the maximum capacity listed in the tables for a fan-assisted **appliance** is reduced by 10% (0.90 x maximum capacity); and
- the **draft hood** outlet is greater than 4 in (102 mm) in diameter. Do not connect a 3 in

(76 mm) diameter **vent** or **vent connector** to a 4 in (102 mm) diameter **draft hood** outlet. This provision shall not apply to fan-assisted **appliances**.

2. Smaller Vents and Vent Connectors May Be Used

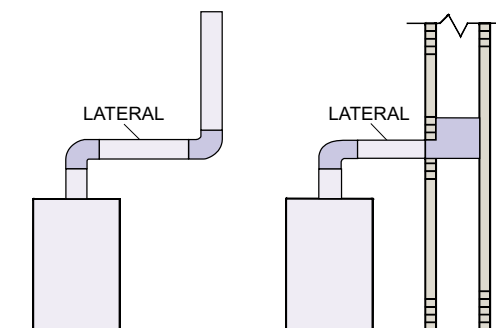
- total vent height must be at least 10 ft
- draft hood outlet must be greater than 4 in diameter
- amount of reduction is limited by flue collar size
- a fan-assisted appliance's maximum capacity as listed in the tables must be reduced by 10%



Note: *Two (2) 45° turns are equivalent to one (1) 90° turn.

3. Elbows or Turns Reduce Vent Capacity

When lateral length is greater than zero, 2 elbows are assumed in Tables C.1 and C.2.



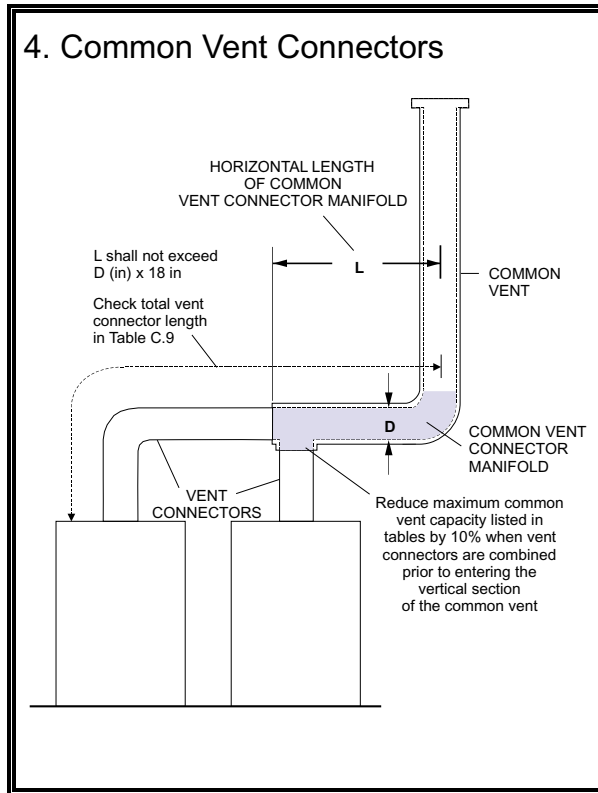
For each additional 90° elbow or equivalent, either in the vent connector or vent, the maximum capacity listed in the venting tables must be reduced by

- 10% for a natural draft appliance (eg, for 2 additional elbows (total of 4 elbows) multiply table values by 0.80)
- 15% for a fan-assisted appliance (eg, for 3 additional elbows (total of 5 elbows) multiply table values by 0.55)

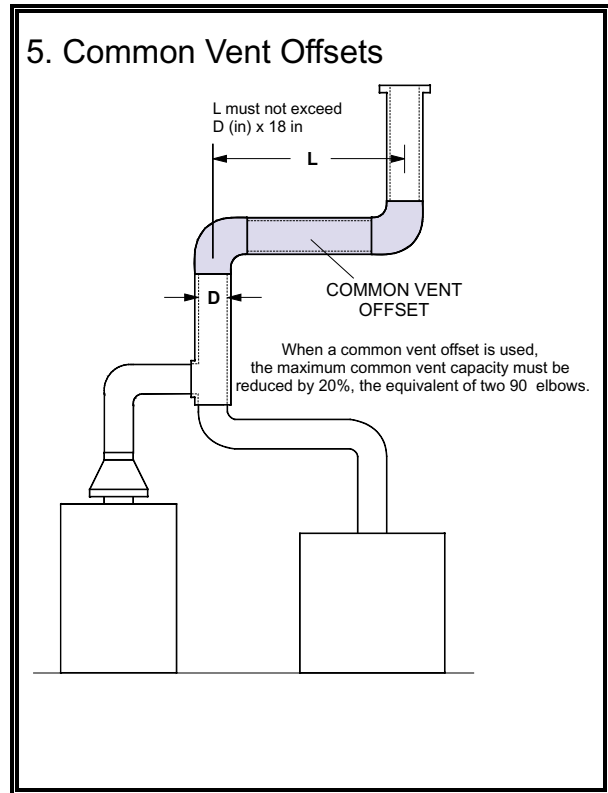
Δ **3.** For a single **appliance** venting configuration with zero lateral lengths, note that Tables C.1 and C.2 are assumed to have no elbows in the **vent system**. For all other vent configurations of single or multiple **appliances**, each **vent connector** shall be assumed to have two (2) 90° turns. For each additional 90° turn, or equivalent*, beyond two, the maximum capacity of each individual **vent connector** listed in the venting table should be reduced by 10% (0.90 x maximum listed capacity) for a **natural draft appliance** and 15% for a fan-assisted **appliance**. Except for manifolded common **vents** (eg, see Figure C.5), the final turn into the vertical **vent** shall be counted as one 90° turn for each **vent connector**.

4. If **vent connectors** are combined prior to entering the common **vent**, the maximum common vent capacity listed in the common venting tables shall be reduced by 10%, the equivalent of one (1) 90° elbow (0.90 x maximum common **vent** capacity). (See Figure C.5.) The horizontal length of the common **vent connector** manifold (L in Figure C.5) should not exceed 1-1/2 ft (457 mm) for each inch (25.4 mm) of common **vent connector** manifold diameter.

4. Common Vent Connectors



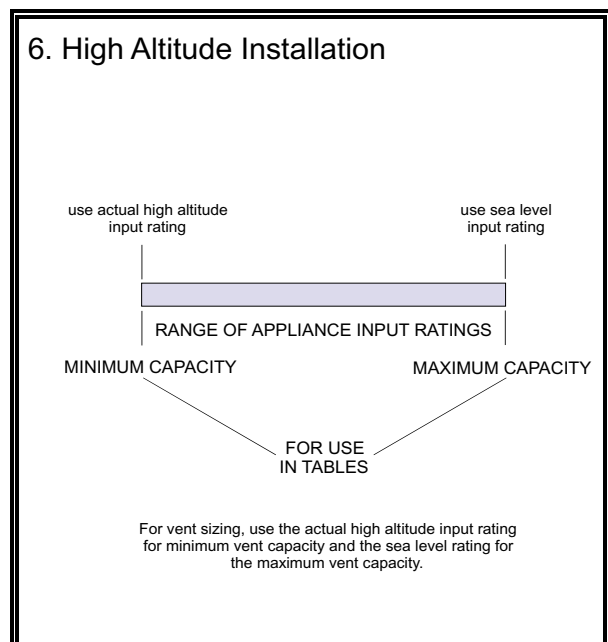
5. Common Vent Offsets



5. If the common vertical **vent** is offset as shown in Figure C.6, the maximum common **vent** capacity listed in the common venting tables should be reduced by 20%, the equivalent of two (2) 90° elbows (0.80 x 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.

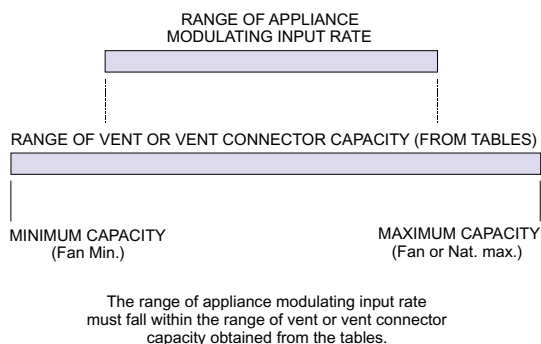
6. Use sea-level input rating when determining maximum capacity for high altitude installation. Use actual input rating for determining minimum capacity for high altitude installation.

6. High Altitude Installation



7. 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.

7. Modulating Input Rates

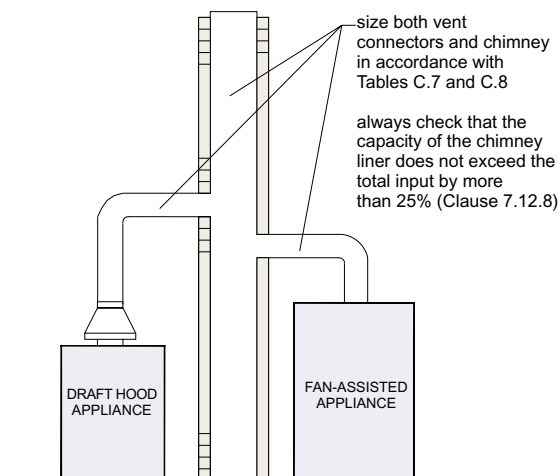


8. A fan-assisted **furnace** may be common-vented into an existing **masonry chimney**, provided that

- (a) the **chimney** is currently serving at least one draft hood-equipped appliance; and
- (b) the **vent connectors** and **chimney** are sized in accordance with Tables C.7 and C.8.

9. 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.

8. Fan-Assisted Appliance Common Venting Through An Existing Masonry Chimney



9. Single Fan-Assisted Appliance Venting

This general requirement is intended to prevent excessive condensation and poor venting performance when a single fan-assisted appliance is vented into a masonry chimney.

In order to maintain a dry, warm vent, a properly sized Type B vent or certified lining system is required.

10. **Certified**, corrugated metallic **chimney** liner systems in **masonry chimneys** shall be sized by using 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 x 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 GVR no. 5).

10. Reduce Maximum Capacity of Certified Corrugated Metallic Chimney Liner Systems by 20%

maximum liner capacity = maximum table capacity x 0.80

minimum liner capacity = minimum table capacity

Always remember to account for bends.

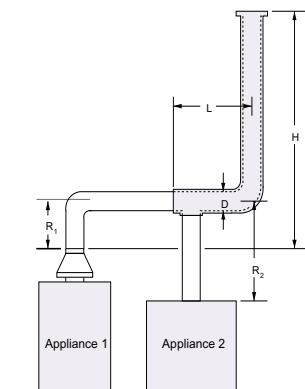
Many manufacturers of corrugated metallic chimney liner systems provide tables that have been adjusted to account for the reduced maximum venting capacity of their products. Ensure that these tables are accurate and based on the venting tables in Appendix C of the B149.1 Code.

11. For multiple units of gas utilization **equipment** all located on one floor, available total height (H) shall be measured from the highest **draft hood** outlet or **flue collar** up to the level of the cap or terminal. **Vent connector** rise (R) shall be measured from the draft hood outlet or **flue collar** to the level where the **vent** gas streams come together. (Not applicable to multi-storey installations.)

11. Multi-Unit Installations

The following convention is used for measurement of multi-unit installations located on one floor level:

- 1) available total height (H) is measured from the highest draft hood outlet or flue collar up to the level of the cap or terminal; and
- 2) connector rise (R) is measured from the draft hood outlet or flue collar to the level where the vent streams come together.



12. For multi-storey installations, available total height for each segment of the system (H) shall be the vertical distance between the highest **draft hood** outlet or **flue collar** entering that segment and the centre line of the next higher interconnection tee. (See Figure C.11.)

13. The size of the lowest **vent connector** and of the vertical **vent** leading to the lowest interconnection of a multi-storey system shall be in accordance with Table C.1 or C.2 for available total height (H) up to the lowest interconnection. (See Figure C.12.)

14. If the desired **vent** height and **vent connector** rise and/or lateral are between the table entries, linear interpolation shall be permitted for calculation of the permissible appliance input ratings. Extrapolation beyond the table entries shall not be acceptable.

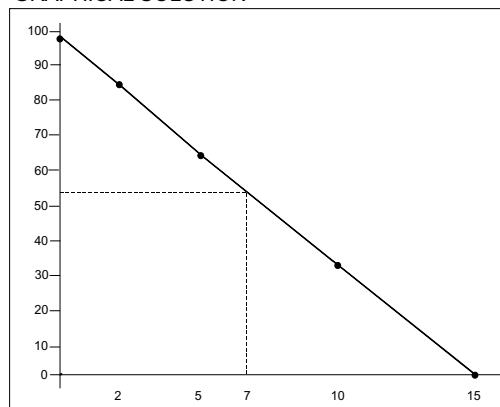
14. Interpolating Table Values

Interpolation is finding the capacity between table values graphically or mathematically

Extract from vent sizing tables		
H (ft)	L (ft)	Btuh x 1000
15	0	98
	2	84
	5	64
	10	38
	15	0

What if
L is 7 feet?

GRAPHICAL SOLUTION



MATHEMATICAL SOLUTION

$$64 - \frac{2}{5} \times (64 - 38) = 53.6 \text{ OR } 53\,600 \text{ Btuh}$$

Extrapolation, or finding the capacity beyond the table values, is not permitted.

15. When the *vent* table permits more than one diameter of pipe to be used for a *vent connector* or *vent*, the smallest permitted diameter shall be preferred.

15. Use Smallest Possible Vent or Vent Connector

Selecting the smallest possible vent or vent connector size improves venting and reduces the potential for condensation.

General Requirements Checklist

- ☐ Is the vent or chimney exposed to cold weather? See #1
- ☐ Is this a new house? See #1
- ☐ Are there any air-exhausting appliances in the building? See #1
- ☐ Is the vent or vent connector size given in the tables smaller than the draft hood outlet or flue collar? See #2
- ☐ Are there more than two 90° elbows or their equivalent? See #3
- ☐ Is there a common vent connector? See #4
- ☐ Is there a vertical vent offset? See #5
- ☐ Is it a high altitude installation? See #6
- ☐ Does the installation involve an appliance with a modulating input rating? See #7
- ☐ Is there common venting of a fan-assisted furnace through an existing masonry chimney? See #8
- ☐ Is a single fan-assisted appliance venting through a tile-lined, masonry chimney? See #9
- ☐ Is a certified, corrugated metallic chimney liner to be used? See #10
- ☐ Is this a multi-unit installation? See #11
- ☐ Is this a multi-storey installation? See #12 and #13
- ☐ Is the vent height, connector rise, and lateral not specified on the tables? See # 14
- ☐ Are two or more diameters permitted for vents or vent connectors in the tables? See #15

How to Use the Vent Sizing Tables

This section of the handbook explains how to use the vent sizing tables for most typical appliance installations.

As was noted earlier, the current version of the vent sizing tables was developed for two main reasons:

- (a) to properly size vents serving fan-assisted appliances; and
- (b) to account for the 5 Pa depressurization limit permitted in houses under the 1995 *National Building Code of Canada*.

These new developments in the vent sizing tables make them appear more complicated than previous versions, but the process of using the tables remains the same. The examples given in this chapter are intended to guide readers in a step-by-step process through a series of vent sizing procedures permitted by the tables. The section at the end of this handbook provides additional examples that further illustrate typical applications of the vent sizing tables.

Some important points to keep in mind when using the vent sizing tables:

- The vent sizing tables in Appendix C to the Code are only intended for natural draft and fan-assisted appliances that are vented to either a Type B vent, a certified chimney liner, or, as permitted, a tile-lined chimney.
- For all other methods of venting, follow the manufacturer's certified installation instructions or consult with your local inspection authority or gas utility.
- Whenever the tables do not show a particular venting system arrangement, this means that the tables cannot be used for this type of arrangement; the venting system, if permitted by the authority having jurisdiction, must be designed and approved.

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. Care must be taken to size their venting properly.

The vent sizing tables in Appendix C that apply to single appliance installations are Tables C.1 and C.2. Table C.1 is used when a Type B vent connector is used. Table C.2 applies to situations where a single-wall vent connector is used. All of the tables are in Imperial units (feet, inches, and thousands of Btuh).

The essential information required to use the tables for a fan-assisted appliance is indicated in the figure appearing on the opposite page. This figure also depicts how this information is used within Table C.1, and it should be noted that this is identical to the procedure using Table C.2. An example is presented below that outlines the vent sizing procedure using Table C.1.

Note: In this and all of the examples that follow, the information in the tables that is required to size vents and vent connectors for a particular appliance or combination of appliances is shaded. Dashed lines indicate which parts of a table correspond to dimensions obtained from a layout of the appliance(s). Heavy circles and lines show the procedures for applying the tables to the example provided.

Example A — Fan-Assisted Appliance with a Type B Vent Connector to a Type B Vent

A fan-assisted furnace with an input rating of 120 000 Btuh is being installed in a storage building. It has a height, H, of 10 ft, and a Type B lateral vent connector with a length, L, of 5 ft. What size of Type B vent is required?

Using Table C.1, the procedure is outlined in the figure on the opposite page. First, find the row in the table with a height of 10 ft. Within the next column, find the row with a lateral length of 5 ft. Proceed across until a range of *Min* and *Max* under the *FAN* column is found that contains 120 000 Btuh. The appropriate range appearing in this row is circled in the figure, indicating a minimum capacity of 41 000 and a maximum capacity of 187 000 Btuh. Look up the column in which this range appears to obtain the vent and vent connector diameter. The table indicates that a 5 in diameter is required.

Note: In some cases, more than one range of capacities in the tables is acceptable. It is recommended to use the smallest acceptable size of vent and vent connector in all cases.

Table C.1
Capacity of Type B Double-Wall Vents with Type B Double-Wall Vent Connectors
Serving a Single Category I Appliance

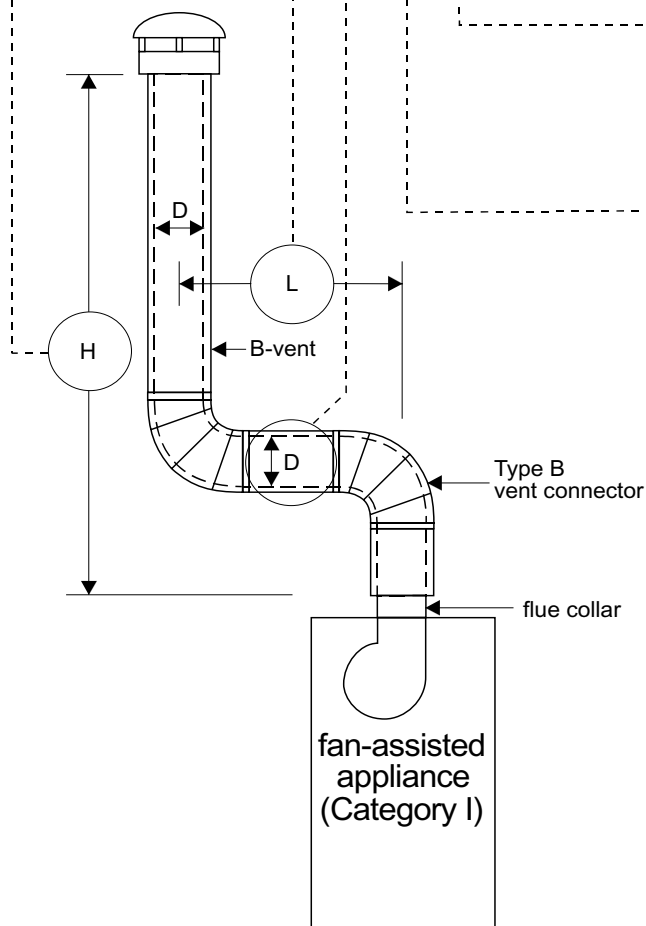
Height H (ft)		Lateral L (ft)		Vent and vent connector diameter - D (in)											
				3				4				⑤			
				Appliance input rating in thousands of Btuh											
				FAN		NAT		FAN		NAT		FAN		NAT	
				Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP
⑩	0	0	88	53	42	0	175	100	79	0	295	166	131		
	2	12	61	42	34	17	118	81	65	23	194	129	103		
	⑤	23	57	40	32	32	113	77	62	④①	187	124	99		
	10	30	51	36	28	41	104	70	55	54	176	115	90		

Obtain input rating from
appliance rating plate

Max column indicates the maximum input allowed for a fan-assisted appliance for the corresponding vent and vent connector diameter

Min column indicates the minimum input allowed for a fan-assisted appliance for the corresponding vent and vent connector diameter

Fan-assisted appliance input must always fall within the **Min** and **Max** range under the **FAN** column.



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

Tables C.1 and C.2 may also be used to size a venting system serving a single draft hood-equipped appliance. However, instead of the *FAN* columns, the *NAT* columns are used. Under the *NAT* column, there are two options. The first is under the *Max* column, and the capacities listed under this column correspond exactly to the older versions of the vent sizing tables. The *Max* column applies to situations where an appliance is installed in a leaky building without air-exhausting appliances or equipment.

The second option, which should be used in almost every instance, is under the *DP* column. The *DP* column capacities were developed to account for the maximum 5 Pa negative pressure (depressurization) permitted under the 1995 *National Building Code of Canada*. 5 Pa depressurization represents the threshold beyond which the spillage of fan-assisted and natural draft appliances will occur.

The vent sizing tables in Appendix C that apply to single appliance installations are Tables C.1 and C.2. Table C.1 is used when a Type B vent connector is used. Table C.2 applies to situations where a single-wall vent connector is used. All of the tables are in Imperial units (feet, inches, and thousands of Btuh).

The information required to use the tables for a natural draft (draft hood-equipped) appliance is depicted in the figure on the opposite page.

Example B — Draft Hood-Equipped Appliance with a Single-Wall Vent Connector to a Type B Vent

A 120 000 Btuh pool heater is being installed in a shed. It has a height, *H*, of 10 ft, and a single-wall lateral vent connector with a length, *L*, of 2 ft. What size of Type B vent is required?

Using Table C.2, the procedure is outlined in the figure on the opposite page. First, find the row in the table with a height of 10 ft. Within the next column, find the row with a lateral length of 2 ft. Proceed across until a *Max* capacity greater than or equal to 120 000 Btuh is found under the *NAT* column. The *Max* column is used because the shed is a leaky structure with no air-exhausting appliances. The appropriate capacity is circled in the figure, indicating a maximum vent capacity of 128 000 Btuh. Look up the column in which this capacity appears in order to obtain the vent and vent connector diameter. Table C.2 indicates that a 5 in or larger diameter is required.

Note: If a Type B vent connector was used, then Table C.1 would apply, following the same procedure outlined above.

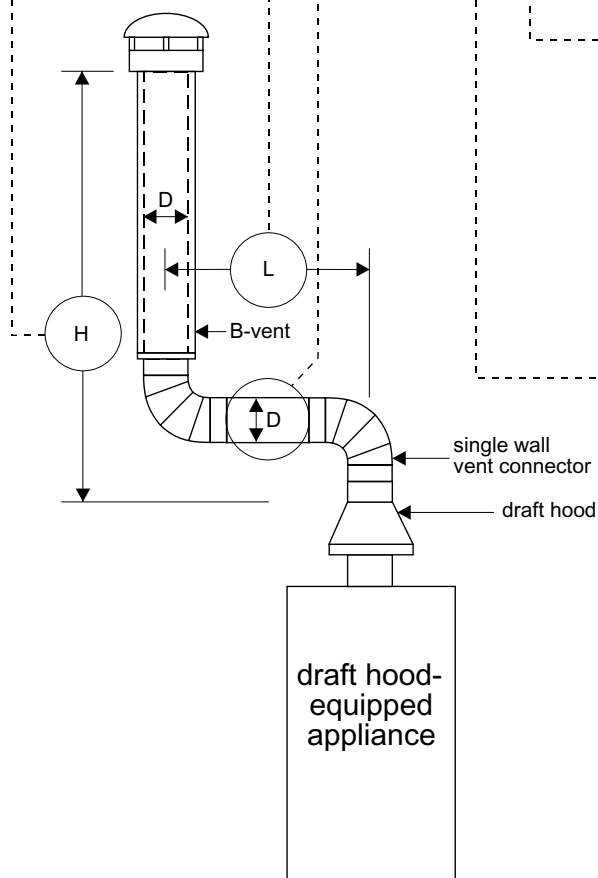
Table C.2
Capacity of Type B Double-Wall Vents with Single-Wall Vent Connectors
Serving a Single Category I Appliance

Height H (ft)	Lateral L (ft)	Vent and vent connector diameter - D (in)												
		3				4				⑤				
		Appliance input rating in thousands of Btuh ←												
		FAN		NAT		FAN		NAT		FAN		NAT		
		Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP	
→ 10	0	37	87	53	42	57	174	99	78	82	293	165	130	←
	②	39	61	41	33	59	117	80	64	82	193	128	102	←
	5	52	56	39	31	76	111	76	61	105	185	122	98	←
	10	NR	NR	34	27	97	100	68	53	132	171	112	87	←

Obtain input rating from
appliance rating plate

DP column used to
determine the maximum
vent capacity when the
appliance is installed in a
tight building or a loose
building with air-
exhausting appliances or
equipment (eg, any
typical new or replacement
installation).

Max column used to
determine the maximum
vent capacity when the
appliance is installed in a
loose building without any
air-exhausting equipment
(eg, pool heater in a leaky
shed enclosure).



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

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

- (a) The chimney must be lined and in good condition.
- (b) The chimney must be warm; it cannot be located on an exterior wall.
- (c) The chimney liner must not be oversized, causing excessive condensation.

Example C — Draft Hood-Equipped Appliance with a Single-Wall Vent Connector to a Tile-Lined Chimney

An 80 000 Btuh replacement boiler is being installed in a bungalow with an internal, tile-lined masonry chimney. It has a height, H , of 15 ft, and a single-wall lateral vent connector with a length, L , of 2 ft. The chimney and 8 in x 8 in liner are in good condition. Can the boiler be vented to the chimney?

Using Table C.6, the procedure is outlined in the figure on the opposite page. First, the size of vent connector must be determined. Find the row in the table with a height of 15 ft. Within the next column, find the row with a lateral length of 2 ft. Proceed across until a DP capacity greater than 80 000 Btuh is found under the NAT column. The DP column is used because the house has a clothes dryer and range hood. The appropriate capacity is circled in the figure, indicating a minimum vent connector diameter of 5 in. The next step is to check if the chimney liner is of a permissible size. There are two checks involved here. First, moving down the column to the bottom two rows, the minimum and maximum internal areas of the chimney are listed and circled. The area of the 8 in x 8 in liner is 42.7 in² (see Table C.10 in Appendix C), which is between 28 and 137 in², so the liner is OK.

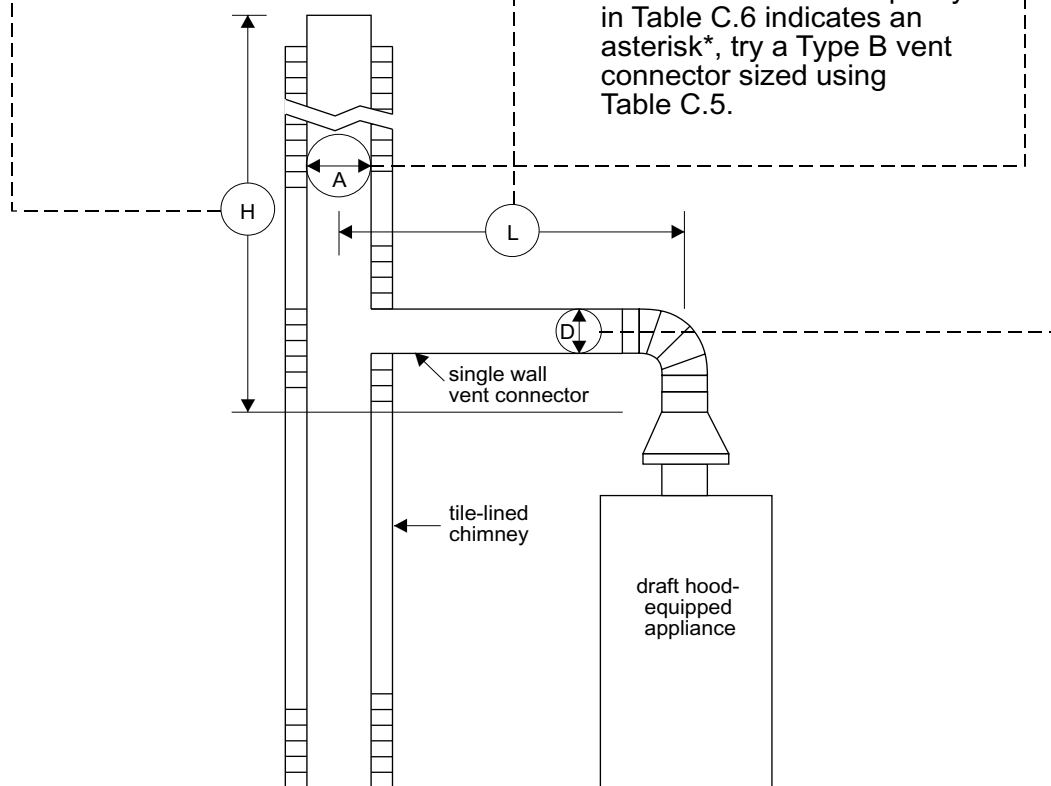
The second check refers to Clause 7.12.8 of the B149.1 Code, which does not permit the listed capacity of the chimney flue to exceed the appliance input rating by more than 25%. For an input of 80 000 Btuh, the limit is $80\,000 \times 1.25 = 100\,000$ Btuh. The listed capacity of the chimney in Table C.6 is 97 000 Btuh; the chimney liner is still OK. If the chimney liner fails either check, a certified liner or B vent must be installed. See **Example G** for a case where the existing liner is oversized.

Note: *In most practical cases, due to the large size of typical chimney flues, it is not permissible or advisable to vent an appliance to a tile-lined chimney, and in many jurisdictions this practice is prohibited. The Code also prohibits the venting of a single fan-assisted appliance to a tile-lined chimney due to the potential for excessive condensation. Consult with your local utility or authority having jurisdiction regarding this practice.*

Table C.6
Capacity of Tile-Lined Masonry Chimneys with Single-Wall Vent Connectors
Serving a Single Category I Appliance

Height H (ft)	Lateral L (ft)	Vent connector diameter - D (in) To be used with chimney areas within the size limits at bottom											
		3				4				⑤			
		Appliance input rating in thousands of Btuh											
		FAN		NAT		FAN		NAT		FAN		NAT	
		Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP
→ ⑮	②	N/A	N/A	35*	30*	N/A	N/A	67	58	N/A	N/A	113	97
-----→	5	N/A	N/A	32*	28*	N/A	N/A	61	52	N/A	N/A	106	91
	10	N/A	N/A	27*	23*	N/A	N/A	54*	46*	N/A	N/A	96	82
	15	N/A	N/A	NR	NR	N/A	N/A	46*	39*	N/A	N/A	87*	74*
Minimum internal area of chimney, in ²		12				19				⑮ ←-----			
Maximum internal area of chimney, in ²		49				88				⑮ ←-----			
*Possibility of continuous condensation													

Note: If the correct capacity in Table C.6 indicates an asterisk*, try a Type B vent connector sized using Table C.5.



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

The sizing of vent connectors and the common vent serving two or more fan-assisted appliances may be performed using Tables C.3 and C.4 of Appendix C. Table C.3 is used when a Type B vent connector is used. Table C.4 applies to situations where a single-wall vent connector is used.

The information required to use the tables for two or more fan-assisted appliances is indicated in the figure appearing on the opposite page. This figure also depicts how this information is used within Table C.3, and it should be noted that this is identical to the procedure using Table C.4. An example is presented below that outlines the vent sizing procedure using Table C.3.

Example D — Two Fan-Assisted Appliances with a Type B Vent Connector to a Type B Common Vent

A fan-assisted furnace and a fan-assisted boiler are being installed in a building. The fan-assisted furnace has an input rating of 40 000 Btuh, and a vent connector rise, R_1 , of 2 ft. The boiler has an input rating of 80 000 Btuh, and a vent connector rise, R_2 , of 3 ft. The Type B common vent has a height, H , of 20 ft. What sizes of Type B common vent and vent connectors are required?

Using Table C.3, the procedure is outlined in the figure on the opposite page. The first step is to size the vent connectors. Beginning with the furnace, find the row in the table with a height of 20 ft. Within the next column, find the row with a vent connector rise of 2 ft. Proceed across until a range of *Min* and *Max* under the *FAN* column is found that contains 40 000 Btuh. The appropriate range appearing in this row is circled in the figure, indicating a minimum capacity of 22 000 and a maximum capacity of 57 000 Btuh. Look up the column in which this range appears to obtain a vent connector diameter of 3 in. The same procedure is followed for the boiler, using a

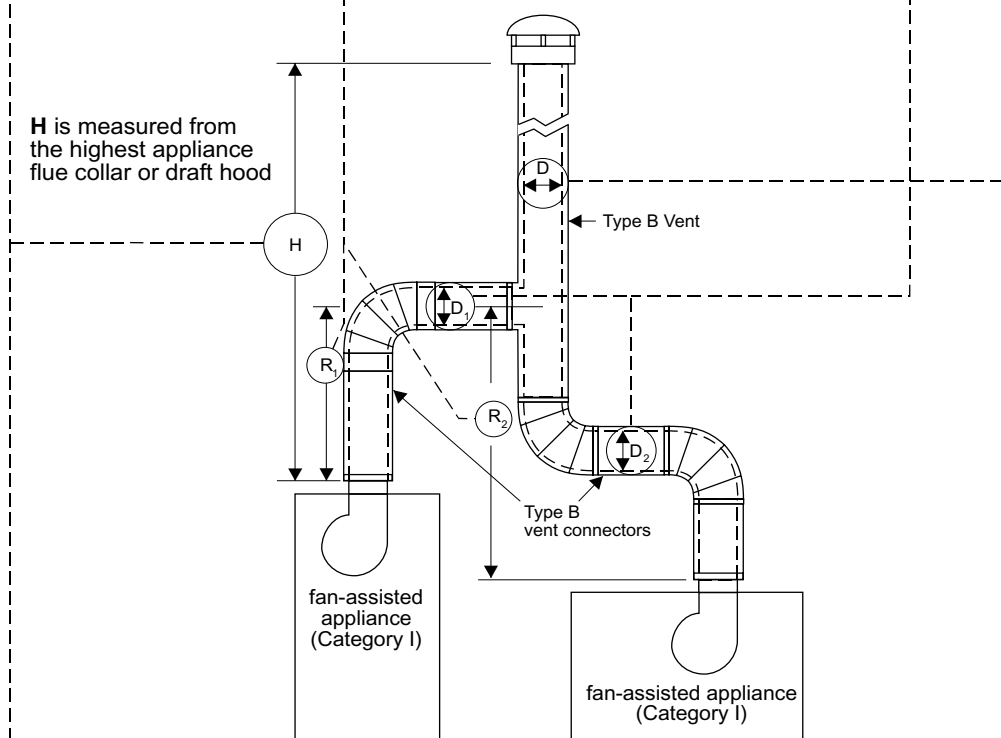
vent connector rise of 3 ft and an input of 80 000 Btuh. The result is also a 4 in vent connector.

The next step is to size the common vent connector using the common vent capacity part of Table C.3. The combined capacity of the appliances, $40\,000 + 80\,000 = 120\,000$ Btuh, is used here. Begin at a vent height of 20 ft in the first column and move across the table until the first *FAN+FAN* column equal to or greater than 120 is found. The first *FAN+FAN* column lists a capacity of 136 000 Btuh corresponding to a 4 in common vent size.

Note: *In the example above, a vent connector larger than 4 in could be used for the furnace since its capacity falls within the 34 000 to 105 000 Btuh range in Table C.3. A 5 in vent connector could also be used for the boiler. However, **General Venting Requirement #15** states the smallest acceptable diameter for vents and vent connectors is preferred.*

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 connector diameter - D (in)													
Vent height H (ft)	Vent connector rise R (ft)	3				④				5			
		Appliance input rating limits in thousands of Btuh											
		FAN		NAT		FAN		NAT		FAN		NAT	
		Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP
→ 20	1	21	54	31	28	33	99	56	50	46	157	87	78
	2	22	57	37	33	34	105	66	59	48	167	104	94
	3	23	60	42	38	35	110	74	67	50	176	116	104



Common Vent Capacity

Vent height H (ft)	Common vent diameter - D (in)														
	4					5					6				
	Combined appliance input rating limits in thousands of Btuh														
	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP
	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)
6	92	81	49	65	40	140	116	71	103	63	204	161	98	147	90
8	101	90	64	73	52	155	129	92	114	81	224	178	126	163	116
10	110	97	76	79	62	169	141	110	124	97	243	194	151	178	139
15	125	112	95	91	77	195	164	139	144	122	283	228	194	206	175
20	136	123	111	102	92	215	183	165	160	144	314	255	230	229	206

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

The sizing of vent connectors and the common vent serving two or more draft hood-equipped appliances may be performed using Tables C.3 and C.4 of Appendix C. Table C.3 is used when a Type B vent connector is used. Table C.4 applies to situations where a single-wall vent connector is used.

The information required to use the tables for two or more draft hood-equipped appliances is indicated in the figure appearing on the opposite page. This figure also depicts how this information is used within Table C.4, and it should be noted that this is identical to the procedure using Table C.3. An example is presented below that outlines the vent sizing procedure using Table C.4.

Example E — Two Draft Hood-Equipped Appliances with Single-Wall Vent Connectors to a Type B Common Vent

A draft hood-equipped water heater and a draft hood-equipped boiler are being installed in a house. The water heater has an input rating of 40 000 Btuh and a vent connector rise, R_1 , of 2 ft. The boiler has an input rating of 80 000 Btuh and a vent connector rise, R_2 , of 3 ft. The Type B common vent has a height, H , of 30 ft. What sizes of vent connectors and common vent are required?

Using Table C.4, the procedure is outlined in the figure on the opposite page. The first step is to size the vent connectors. Beginning with the water heater, find the row in the table with a height of 30 ft. Within the next column, find the row with a vent connector rise of 2 ft. Proceed across until a *DP* capacity under the *NAT* column that is greater than or equal to 40 000 Btuh is found. The appropriate capacity in this row is circled in the figure, indicating a capacity of 62 000 Btuh. Look up the column in which this range appears in order to obtain a minimum vent connector diameter of 4 in. The same is done for

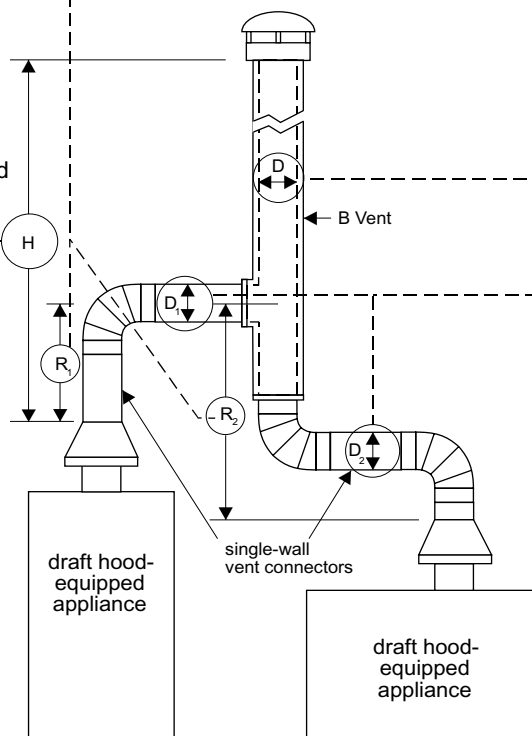
the boiler, using a vent connector rise of 3 ft and an input of 80 000 Btuh. Proceed across until a *DP* capacity under the *NAT* column that is greater than or equal to 80 000 Btuh is found. The appropriate capacity in this row is circled in the figure, indicating a capacity of 112 000 Btuh. Look up the column in which this range appears to obtain a minimum vent connector diameter of 5 in.

The next step is to size the common vent connector using the common vent capacity part of Table C.4. The combined capacity of the appliances, $40\,000 + 80\,000 = 120\,000$ Btuh, is used here. Begin at a vent height of 30 ft in the first column and move across the table until the first *DP* (*N+N*) column equal to or greater than 120 is found. The second *DP* (*N+N*) column lists a capacity of 166 000 Btuh corresponding to a minimum 5 in common vent size.

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 (in)															
		3				④				⑤							
		Appliance input rating limits in thousands of Btuh															
		FAN			DP	NAT			DP	FAN			DP	NAT			DP
		Min	Max	Max		Min	Max	Max		Min	Max	Max		Min	Max	Max	
→ 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				

H is measured from the highest appliance flue collar or draft hood



Common Vent Capacity

Vent height H (ft)	Common vent diameter - D (in)														
	4					5					6				
	Combined appliance input rating limits in thousands of Btuh														
	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP
	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)
10	106	94	73	76	59	163	137	107	120	94	237	189	147	174	136
15	121	108	92	88	75	189	159	135	140	119	275	221	188	200	170
20	131	118	106	98	88	208	177	159	155	140	305	247	222	223	201
30	145	132	123	113	105	236	202	188	179	166	350	286	266	257	239
50	159	145	139	128	123	268	233	224	204	196	406	337	324	296	284

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

The sizing of vent connectors and the common vent serving a combination of fan-assisted and draft hood-equipped appliances may be performed using Tables C.3 and C.4 of Appendix C. Table C.3 is used when Type B vent connectors are used. Table C.4 applies to situations where single-wall vent connectors are used.

The information required to use the tables for a combination of two appliances is indicated in the figure appearing on the opposite page. This figure also depicts how this information is used within Table C.3, and it should be noted that this is identical to the procedure using Table C.4. An example is presented below that outlines the vent sizing procedure using Table C.3.

Example F — A Fan-Assisted and a Draft Hood-Equipped Appliance with Type B Vent Connectors to a Type B Common Vent

A draft hood-equipped water heater and a fan-assisted boiler are being installed in a new house. The draft hood-equipped water heater has an input rating of 40 000 Btuh and a vent connector rise, R_1 , of 2 ft. The fan-assisted boiler has an input rating of 80 000 Btuh and a vent connector rise, R_2 , of 3 ft. The Type B common vent has a height, H , of 20 ft. What sizes of Type B common vent and vent connectors are required?

Using Table C.3, the procedure is outlined in the figure on the opposite page. The first step is to size the vent connectors. Beginning with the water heater, find the row in the table with a height of 20 ft. Within the next column, find the row with a vent connector rise of 2 ft. Proceed across until a DP capacity under the NAT column greater than or equal to 40 000 Btuh is found. The appropriate capacity appearing in this row is circled in the figure, indicating 59 000 Btuh.

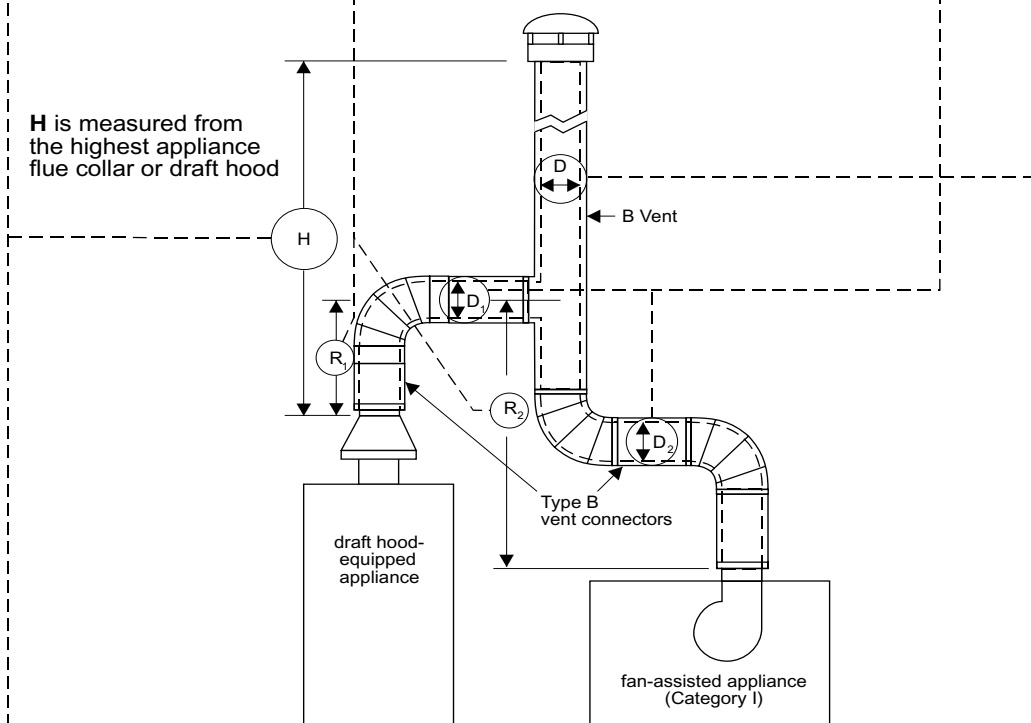
Look up the column in which this range appears in order to obtain a vent connector diameter of 4 in.

The procedure is followed for the boiler, using a vent connector rise of 3 ft and an input of 80 000 Btuh corresponding to the *FAN Min Max* columns of the table. The result is also a 4 in vent connector.

The next step is to size the common vent connector using the common vent capacity part of Table C.3. The combined capacity of the appliances, $40\,000 + 80\,000 = 120\,000$ Btuh, is used here. Begin at a vent height of 20 ft in the first column and move across the table until the first $DP(F+N)$ column equal to or greater than 120 is found. This is the second $DP(F+N)$ column, which lists a capacity of 165 000 Btuh corresponding to a 5 in common vent size.

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 connector diameter - D (in)													
Vent height H (ft)	Vent connector rise R (ft)	3				④				5			
		Appliance input rating limits in thousands of Btuh											
		FAN		NAT		FAN		NAT		FAN		NAT	
		Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP
→ 20	1	21	54	31	28	33	99	56	50	46	157	87	78
	2	22	57	37	33	34	105	66	59	48	167	104	94
	3	23	60	42	38	35	110	74	67	50	176	116	104



Common Vent Capacity

Vent height H (ft)	Common vent diameter - D (in)														
	4					⑤					6				
	Combined appliance input rating limits in thousands of Btuh														
	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP
	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)
6	92	81	49	65	40	140	116	71	103	63	204	161	98	147	90
8	101	90	64	73	52	155	129	92	114	81	224	178	126	163	116
10	110	97	76	79	62	169	141	110	124	97	243	194	151	178	139
15	125	112	95	91	77	195	164	139	144	122	283	228	194	206	175
→ 20	136	123	111	102	92	215	183	165	160	144	314	255	230	229	206

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

This example presents a situation where it is necessary to replace older appliances that are connected to a tile-lined masonry chimney. In this case, unlike **Example C**, the chimney is oversized, and this example explains how to determine oversizing.

Example G — A Fan-Assisted and a Draft Hood-Equipped Appliance with Type B Vent Connectors to a Tile-Lined Chimney

A fan-assisted boiler and a draft hood-equipped water heater are being installed to replace two existing appliances connected to a chimney with an 8 in x 12 in tile liner. The fan-assisted boiler has an input rating of 80 000 Btuh, and a vent connector rise, R_1 , of 1 ft. The draft hood-equipped water heater has an input rating of 40 000 Btuh, and a vent connector rise, R_2 , of 2 ft. The chimney has a height, H , of 30 ft. What sizes of Type B vent connectors are required? Is it permissible to use the existing tile liner?

Using Table C.7, the procedure is outlined in the figure on the opposite page. The first step is to size the vent connectors. Beginning with the boiler, find the row in the table with a height of 30 ft. Within the next column, find the row with a vent connector rise of 1 ft. Proceed across until a *Min Max* range under a *FAN* column containing 80 000 Btuh is found. The capacity appearing in this row is circled in the figure, indicating between 37 000 and 111 000 Btuh. Look up the column in which this range appears in order to obtain a vent connector diameter of 4 in. The same procedure is followed for the water heater, using a vent connector rise of 2 ft and an input of 40 000 Btuh corresponding to a *NAT DP* column. The result is also a 4 in vent connector.

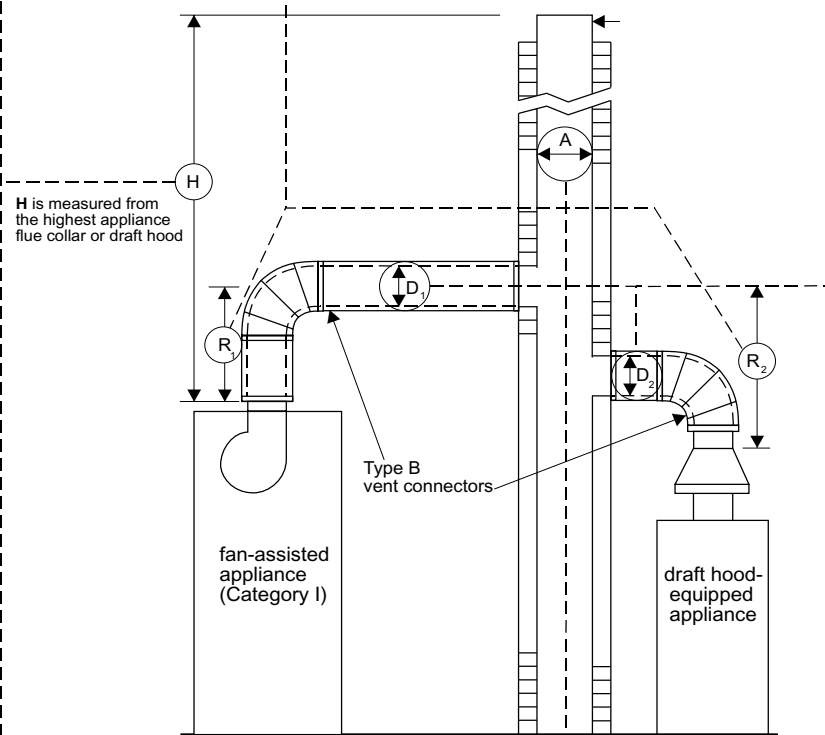
The next step is to check if the chimney liner is of a permissible size using the common vent capacity part of Table C.7. The combined capacity of the appliances, $80\,000 + 40\,000 = 120\,000$ Btuh, is used. There are two checks involved in this

procedure. The first check is to see if the liner is too small. Starting at the 30 ft vent height in the first column, move across until the first *DP (F+N)* column with a capacity greater than or equal to the combined capacity of the appliances is found. A listed capacity of 251 000 Btuh is found, corresponding to a minimum internal chimney area of 28 in^2 . An 8 in x 12 in tile liner has an area of 63.6 in^2 ; the liner is not too small.

The second check refers to Clause 7.12.8 of the B149.1 Code, which does not permit the listed capacity of the chimney flue to exceed the combined appliance input rating by more than 25%. For a combined input of 120 000 Btuh, the limit is $120\,000 \times 1.25 = 150\,000$ Btuh. The listed capacity of the chimney in Table C.7 is 251 000 Btuh, hence it is not permissible to vent these appliances to the chimney. A certified liner or B Vent would have to be correctly sized and installed. See **Example 9** on page 232 of this handbook.

Table C.7
Capacity of Masonry Chimneys 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 (in)														
		3				4				5						
		Appliance input rating limits in thousands of Btuh														
		FAN			NAT	DP	FAN			NAT	DP	FAN			NAT	DP
		Min	Max	Max			Min	Max	Max			Min	Max	Max		
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			



Common Vent Capacity

Vent height H (ft)	Minimum internal area of chimney - A (in ²)														
	12					19					28				
	Combined appliance input rating limits in thousands of Btuh														
	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP
	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)
10	NR	84	66	31	24	NR	138	108	56	44	NR	207	161	90	70
15	NR	90	77	36	31	NR	152	129	67	57	NR	233	198	106	90
20	NR	92	83	41	37	NR	159	143	75	68	NR	250	225	122	110
30	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	270	251	137	127
50	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

Multi-Storey Appliance Venting

Multi-storey appliance venting is beyond the scope of this handbook; however, there are some practical considerations for installers who encounter a multi-storey venting system.

There are two typical situations:

- (a) A completely new multi-storey venting system is being designed and installed.
- (b) An appliance, or group of appliances, connected to an existing multi-storey venting system is being replaced with new equipment.

New Multi-Storey Venting Systems

The design of these systems requires specialized knowledge and experience, and should only be performed by qualified personnel. Some key points to bear in mind regarding multi-storey venting systems:

- Obtain a competent design for a multi-storey venting system from a design professional or the venting system manufacturer.
- Review the design with your local inspection authority and/or utility prior to installation; avoid costly surprises.
- Install the system according the design drawings and specifications. Do not substitute for certified components without prior approval. Where the system has been engineered, ensure that the designer reviews the installation prior to closing in.
- Arrange and coordinate inspections according to your workplan; avoid delays.

Replacing Appliances in an Existing Multi-Storey Venting System

A more common situation encountered by installers involves replacing appliances connected to a multi-storey venting system. This work should be performed with the following points in mind:

- It is recommended that the replacement appliance(s) be of the same size (output capacity) and venting type (fan-assisted or natural draft) as the original. Replacement appliances should be compatible with the multi-storey venting system.
- Do not make significant changes to the venting system or add additional appliance inputs without first seeking competent advice.
- If, for any reason, venting system performance problems are observed or reported, do not proceed with any alteration to the system or connect appliances without contacting your local inspection authority or utility.

Table C.1
Capacity of Type B Double-Wall Vents with Type B Double-Wall Vent Connectors
Serving a Single Category I Appliance

Height H (ft)	Lateral L (ft)	Vent and vent connector diameter - D (in)															
		3				4				5				6			
		Appliance input rating in thousands of Btuh															
		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT	
		Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP
6	0	0	78	46	29	0	152	86	53	0	251	141	87	0	375	205	127
	2	13	51	36	22	18	97	67	41	27	157	105	64	32	232	157	96
	4	21	49	34	20	30	94	64	38	39	153	103	61	50	227	153	90
	6	25	46	32	19	36	91	61	36	47	149	100	59	59	223	149	88
8	0	0	84	50	37	0	165	94	69	0	276	155	113	0	415	235	172
	2	12	57	40	29	16	109	75	55	25	178	120	88	28	263	180	131
	5	23	53	38	27	32	103	71	50	42	171	115	82	53	255	173	123
	8	28	49	35	25	39	98	66	47	51	164	109	77	64	247	165	117
10	0	0	88	53	42	0	175	100	79	0	295	166	131	0	447	255	201
	2	12	61	42	34	17	118	81	65	23	194	129	103	26	289	195	156
	5	23	57	40	32	32	113	77	62	41	187	124	99	52	280	188	150
	10	30	51	36	28	41	104	70	55	54	176	115	90	67	267	175	137
15	0	0	94	58	50	0	191	112	96	0	327	187	161	0	502	285	245
	2	11	69	48	41	15	136	93	80	20	226	150	129	22	339	225	194
	5	22	65	45	38	30	130	87	74	39	219	142	121	49	330	217	184
	10	29	59	41	35	40	121	82	70	51	206	135	115	64	315	208	177
	15	35	53	37	31	48	112	76	65	61	195	128	109	76	301	198	168
20	0	0	97	61	55	0	202	119	107	0	349	202	182	0	540	307	276
	2	10	75	51	46	14	149	100	90	18	250	166	149	20	377	249	224
	5	21	71	48	43	29	143	96	85	38	242	160	142	47	367	241	214
	10	28	64	44	39	38	133	89	79	50	229	150	134	62	351	228	203
	15	34	58	40	36	46	124	84	75	59	217	142	126	73	337	217	193
	20	48	52	35	31	55	116	78	69	69	206	134	119	84	322	206	183
30	0	0	100	64	60	0	213	128	119	0	374	220	205	0	587	336	312
	2	9	81	56	52	13	166	112	104	14	283	185	172	18	432	280	260
	5	21	77	54	50	28	160	108	100	36	275	176	164	45	421	273	254
	10	27	70	50	47	37	150	102	95	48	262	171	159	59	405	261	243
	15	33	64	NR	NR	44	141	96	89	57	249	163	152	70	389	249	232
	20	56	58	NR	NR	53	132	90	84	66	237	154	143	80	374	237	220
	30	NR	NR	NR	NR	73	113	NR	NR	88	214	NR	NR	104	346	219	204
50	0	0	101	67	64	0	216	134	127	0	397	232	220	0	633	363	345
	2	8	86	61	58	11	183	122	116	14	320	206	196	15	497	314	298
	5	20	82	NR	NR	27	177	119	113	35	312	200	190	43	487	308	293
	10	26	76	NR	NR	35	168	114	108	45	299	190	181	56	471	298	283
	15	59	70	NR	NR	42	158	NR	NR	54	287	180	171	66	455	288	274
	20	NR	NR	NR	NR	50	149	NR	NR	63	275	169	161	76	440	278	264
	30	NR	NR	NR	NR	69	131	NR	NR	84	250	NR	NR	99	410	259	246
100	0	NR	NR	NR	NR	0	218	NR	NR	0	407	NR	NR	0	665	400	380
	2	NR	NR	NR	NR	10	194	NR	NR	12	354	NR	NR	13	566	375	356
	5	NR	NR	NR	NR	26	189	NR	NR	33	347	NR	NR	40	557	369	351
	10	NR	NR	NR	NR	33	182	NR	NR	43	335	NR	NR	53	542	361	343
	15	NR	NR	NR	NR	40	174	NR	NR	50	321	NR	NR	62	528	353	335
	20	NR	NR	NR	NR	47	166	NR	NR	59	311	NR	NR	71	513	344	327
	30	NR	NR	NR	NR	NR	NR	NR	NR	78	290	NR	NR	92	483	NR	NR
	50	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	147	428	NR	NR

Table C.1 (Continued)

Height H (ft)	Lateral L (ft)	Vent and vent connector diameter - D (in)											
		7				8				9			
		Appliance input rating in thousands of Btuh											
		FAN		NAT		FAN		NAT		FAN		NAT	
		Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP
6	0	0	524	285	177	0	698	370	229	0	897	470	291
	2	44	321	217	132	53	425	285	174	63	543	370	226
	4	66	316	211	124	79	419	279	165	93	536	362	214
	6	78	310	205	121	93	413	273	161	110	530	354	209
8	0	0	583	320	234	0	780	415	303	0	1006	537	392
	2	42	365	247	180	50	483	322	235	60	619	418	305
	5	70	356	237	168	83	473	313	222	99	607	407	289
	8	84	347	227	161	99	463	303	215	117	596	396	281
10	0	0	631	345	273	0	847	450	356	0	1096	585	462
	2	40	402	273	218	48	533	355	284	57	684	457	366
	5	68	392	263	210	81	522	346	277	95	671	446	357
	10	88	376	245	191	104	504	330	257	122	651	427	333
15	0	0	716	390	335	0	970	525	452	0	1263	682	587
	2	38	475	316	272	45	633	414	356	53	815	544	468
	5	64	463	300	255	76	620	403	343	90	800	529	450
	10	84	445	288	245	99	600	386	328	116	777	507	431
	15	98	429	275	234	115	580	373	317	134	755	491	417
20	0	0	776	430	387	0	1057	575	518	0	1384	752	677
	2	33	531	346	311	41	711	470	423	50	917	612	551
	5	62	519	337	300	73	697	460	409	86	902	599	533
	10	81	499	321	286	95	675	443	394	112	877	576	513
	15	94	481	308	274	111	654	427	380	129	853	557	496
	20	107	464	295	263	125	634	410	365	145	830	537	478
30	0	0	853	475	442	0	1173	650	605	0	1548	855	795
	2	27	613	394	366	33	826	535	498	42	1072	700	651
	5	58	600	385	358	69	811	524	487	82	1055	688	640
	10	77	580	371	345	91	788	507	472	107	1028	668	621
	15	90	560	357	332	105	765	490	456	124	1002	648	603
	20	102	542	343	319	119	743	473	440	139	977	628	584
	30	131	507	321	299	149	702	444	413	171	929	594	552
50	0	0	932	518	492	0	1297	708	673	0	1730	952	904
	2	22	715	445	423	26	975	615	584	33	1276	813	772
	5	55	702	438	416	65	960	605	575	77	1259	798	758
	10	73	681	426	405	86	935	589	560	101	1230	773	734
	15	85	662	413	392	100	911	572	543	117	1203	747	710
	20	97	642	401	381	113	888	556	528	131	1176	722	686
	30	123	605	376	357	141	844	522	496	161	1125	670	637
100	0	0	997	560	532	0	1411	770	732	0	1908	1040	988
	2	18	831	510	485	21	1155	700	665	25	1536	935	888
	5	52	820	504	479	60	1141	692	657	71	1519	926	880
	10	68	801	493	468	80	1118	679	645	94	1492	910	865
	15	80	782	482	458	93	1095	666	633	109	1465	895	850
	20	90	763	471	447	105	1073	653	620	122	1438	880	836
	30	115	726	449	427	131	1029	627	596	149	1387	849	807
	50	180	651	405	385	197	944	575	546	217	1288	787	748

Table C.1 (Continued)

Height H (ft)	Lateral L (ft)	Vent and vent connector diameter - D (in)															
		10				12				14				16			
		Appliance input rating in thousands of Btuh															
		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT	
		Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP
6	0	0	1121	570	353	0	1645	850	527	0	2267	1170	725	0	2983	1530	949
	2	75	675	455	278	103	982	650	397	138	1346	890	543	178	1769	1170	714
	4	110	668	445	263	147	975	640	378	191	1338	880	519	242	1761	1160	684
	6	128	661	435	257	171	967	630	372	219	1330	870	513	276	1753	1150	679
8	0	0	1261	660	482	0	1858	970	708	0	2571	1320	964	0	3399	1740	1270
	2	71	770	515	376	98	1124	745	544	130	1543	1020	745	168	2030	1340	978
	5	115	758	503	357	154	1110	733	520	199	1528	1010	717	251	2013	1330	944
	8	137	746	490	348	180	1097	720	511	231	1514	1000	710	289	2000	1320	937
10	0	0	1377	720	569	0	2036	1060	837	0	2825	1450	1146	0	3742	1925	1521
	2	68	852	560	448	93	1244	850	680	124	1713	1130	904	161	2256	1480	1184
	5	112	839	547	438	149	1229	829	663	192	1696	1105	884	243	2238	1461	1169
	10	142	817	525	410	187	1204	795	620	238	1669	1080	842	298	2209	1430	1115
15	0	0	1596	840	722	0	2380	1240	1066	0	3323	1720	1479	0	4423	2270	1952
	2	63	1019	675	581	86	1495	985	847	114	2062	1350	1161	147	2719	1770	1522
	5	105	1003	660	561	140	1476	967	822	182	2041	1327	1128	229	2696	1748	1486
	10	135	977	635	540	177	1446	936	796	227	2009	1289	1096	283	2659	1712	1455
	15	155	953	610	519	202	1418	905	769	257	1976	1250	1063	318	2623	1675	1424
20	0	0	1756	930	837	0	2637	1350	1215	0	3701	1900	1710	0	4948	2520	2268
	2	59	1150	755	680	81	1694	1100	990	107	2343	1520	1368	139	3097	2000	1800
	5	101	1133	738	657	135	1674	1079	960	174	2320	1498	1333	219	3071	1978	1760
	10	130	1105	710	632	172	1641	1045	930	220	2282	1460	1299	273	3029	1940	1727
	15	150	1078	688	612	195	1609	1018	906	248	2245	1425	1268	306	2988	1910	1700
	20	167	1052	665	592	217	1578	990	881	273	2210	1390	1237	335	2948	1880	1673
30	0	0	1977	1060	986	0	3004	1550	1442	0	4252	2170	2018	0	5725	2920	2716
	2	54	1351	865	804	74	2004	1310	1218	98	2786	1800	1674	127	3696	2380	2213
	5	96	1332	851	791	127	1981	1289	1199	164	2759	1775	1651	206	3666	2350	2186
	10	125	1301	829	771	164	1944	1254	1166	209	2716	1733	1612	259	3617	2300	2139
	15	143	1272	807	751	187	1908	1220	1135	237	2674	1692	1574	292	3570	2250	2093
	20	160	1243	784	729	207	1873	1185	1102	260	2633	1650	1535	319	3523	2200	2046
	30	195	1189	745	693	246	1807	1130	1051	305	2555	1585	1474	369	3433	2130	1981
50	0	0	2231	1195	1135	0	3441	1825	1734	0	4934	2550	2423	0	6711	3440	3268
	2	41	1620	1010	960	66	2431	1513	1437	86	3409	2125	2019	113	4554	2840	2698
	5	90	1600	996	946	118	2406	1495	1420	151	3380	2102	1997	191	4520	2813	2672
	10	118	1567	972	923	154	2366	1466	1393	196	3332	2064	1961	243	4464	2767	2629
	15	136	1536	948	901	177	2327	1437	1365	222	3285	2026	1925	274	4409	2721	2585
	20	151	1505	924	878	195	2288	1408	1338	244	3239	1987	1888	300	4356	2675	2541
	30	183	1446	876	832	232	2214	1349	1282	287	3150	1910	1815	347	4253	2631	2499
100	0	0	2491	1310	1245	0	3925	2050	1948	0	5729	2950	2803	0	7914	4050	3848
	2	30	1975	1170	1112	44	3027	1820	1729	72	4313	2550	2423	95	5834	3500	3325
	5	82	1955	1159	1101	107	3002	1803	1713	136	4282	2531	2404	172	5797	3475	3301
	10	108	1923	1142	1085	142	2961	1775	1686	180	4231	2500	2375	223	5737	3434	3262
	15	126	1892	1124	1068	163	2920	1747	1660	206	4182	2469	2346	252	5678	3392	3222
	20	141	1861	1107	1052	181	2880	1719	1633	226	4133	2438	2316	277	5619	3351	3183
	30	170	1802	1071	1017	215	2803	1663	1580	265	4037	2375	2256	319	5505	3267	3104
	50	241	1688	1000	950	292	2657	1550	1473	350	3856	2250	2138	415	5289	3100	2945

Table C.1 (Continued)

Height H (ft)	Lateral L (ft)	Vent and vent connector diameter - D (in)															
		18				20				22				24			
		Appliance rating in thousands of Btuh															
		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT	
		Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP
6	0	0	3802	1960	1215	0	4721	2430	1507	0	5737	2950	1829	0	6853	3520	2182
	2	225	2250	1480	903	296	2782	1850	1129	360	3377	2220	1354	426	4030	2670	1629
	4	300	2242	1475	870	390	2774	1835	1083	469	3370	2215	1307	555	4023	2660	1569
	6	341	2235	1470	867	437	2767	1820	1074	523	3363	2210	1304	618	4017	2650	1564
8	0	0	4333	2220	1621	0	5387	2750	2008	0	6555	3360	2453	0	7838	4010	2927
	2	212	2584	1700	1241	278	3196	2110	1540	336	3882	2560	1869	401	4634	3050	2227
	5	311	2563	1685	1196	398	3180	2090	1484	476	3863	2545	1807	562	4612	3040	2158
	8	354	2552	1670	1186	450	3163	2070	1470	537	3850	2530	1796	630	4602	3030	2151
10	0	0	4782	2450	1936	0	5955	3050	2410	0	7254	3710	2931	0	8682	4450	3516
	2	202	2868	1890	1512	264	3556	2340	1872	319	4322	2840	2272	378	5153	3390	2712
	5	300	2849	1871	1497	382	3536	2318	1854	458	4301	2818	2254	540	5132	3371	2697
	10	364	2818	1840	1435	459	3504	2280	1778	546	4268	2780	2168	641	5099	3340	2605
15	0	0	5678	2900	2494	0	7099	3620	3113	0	8665	4410	3793	0	10393	5300	4558
	2	186	3467	2260	1944	239	4304	2800	2408	290	5232	3410	2933	346	6251	4080	3509
	5	283	3442	2235	1900	355	4278	2777	2360	426	5204	3385	2877	501	6222	4057	3448
	10	346	3402	2193	1864	432	4234	2739	2328	510	5159	3343	2842	599	6175	4019	3416
	15	385	3363	2150	1828	479	4192	2700	2295	564	5115	3300	2805	665	6129	3980	3383
20	0	0	6376	3250	2925	0	7988	4060	3654	0	9785	4980	4482	0	11753	6000	5400
	2	175	3955	2570	2313	220	4916	3200	2880	269	5983	3910	3519	321	7154	4700	4230
	5	270	3926	2544	2264	337	4885	3174	2825	403	5950	3880	3453	475	7119	4662	4149
	10	334	3880	2500	2225	413	4835	3130	2786	489	5896	3830	3409	573	7063	4600	4094
	15	372	3835	2465	2194	459	4786	3090	2750	541	5844	3795	3378	631	7007	4575	4072
	20	404	3791	2430	2163	495	4737	3050	2715	585	5792	3760	3346	689	6953	4550	4050
30	0	0	7420	3770	3506	0	9341	4750	4418	0	11483	5850	5441	0	13848	7060	6566
	2	159	4734	3050	2837	199	5900	3810	3543	241	7194	4650	4325	285	8617	5600	5208
	5	252	4701	3020	2809	312	5863	3783	3518	373	7155	4622	4298	439	8574	5552	5163
	10	316	4647	2970	2762	386	5803	3739	3477	456	7090	4574	4254	535	8505	5471	5088
	15	354	4594	2920	2716	431	5744	3695	3436	507	7026	4527	4210	590	8437	5391	5014
	20	384	4542	2870	2669	467	5686	3650	3395	548	6964	4480	4166	639	8370	5310	4938
	30	440	4442	2785	2590	540	5574	3565	3315	635	6842	4375	4069	739	8239	5225	4859
50	0	0	8774	4460	4237	0	11129	5635	5353	0	13767	6940	6593	0	16694	8430	8009
	2	141	5864	3670	3487	171	7339	4630	4399	209	8980	5695	5410	251	10788	6860	6517
	5	234	5826	3639	3457	283	7295	4597	4367	336	8933	5654	5371	394	10737	6818	6477
	10	295	5763	3585	3406	355	7224	4542	4315	419	8855	5585	5306	491	10652	6749	6412
	15	330	5701	3534	3357	396	7155	4511	4285	465	8779	5546	5269	542	10570	6710	6375
	20	361	5641	3481	3307	433	7086	4479	4255	506	8704	5506	5231	586	10488	6670	6337
	30	412	5523	3431	3259	494	6953	4421	4200	577	8557	5444	5172	672	10328	6603	6273
100	0	0	10485	5300	5035	0	13454	6700	6365	0	16817	8600	8170	0	20578	10300	9785
	2	120	7591	4600	4370	138	9577	5800	5510	169	11803	7200	6840	204	14264	8800	8360
	5	208	7548	4566	4338	245	9528	5769	5481	293	11748	7162	6804	341	14204	8756	8318
	10	268	7478	4509	4284	318	9447	5717	5431	374	11658	7100	6745	436	14105	8683	8249
	15	304	7409	4451	4228	358	9367	5665	5382	418	11569	7037	6685	487	14007	8610	8180
	20	330	7341	4394	4174	387	9289	5613	5332	452	11482	6975	6626	523	13910	8537	8110
	30	378	7209	4279	4065	446	9136	5509	5234	514	11310	6850	6508	592	13720	8391	7971
	50	486	6956	4050	3848	572	8841	5300	5035	659	10979	6600	6270	752	13354	8100	7695

Table C.2

**Capacity of Type B Double-Wall Vents with Single-Wall Metal Vent Connectors
Serving a Single Category I Appliance**

Height H (ft)	Lateral L (ft)	Vent and vent connector diameter - D (in)																			
		3				4				5				6				7			
		Appliance input rating in thousands of Btuh																			
		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT	
Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP		
6	0	38	77	45	28	59	151	85	53	85	249	140	87	126	373	204	126	165	522	284	176
	2	39	51	36	22	60	96	66	40	85	156	104	63	123	231	156	95	159	320	213	130
	4	NR	NR	33	19	74	92	63	37	102	152	102	60	146	225	152	90	187	313	208	123
	6	NR	NR	31	18	83	89	60	35	114	147	99	58	163	220	148	87	207	307	203	120
8	0	37	83	50	37	58	164	93	68	83	273	154	112	123	412	234	171	161	580	319	233
	2	39	56	39	28	59	108	75	55	83	176	119	87	121	261	179	131	155	363	246	180
	5	NR	NR	37	26	77	102	69	49	107	168	114	81	151	252	171	121	193	352	235	167
	8	NR	NR	33	23	90	95	64	45	122	161	107	76	175	243	163	116	223	342	225	160
10	0	37	87	53	42	57	174	99	78	82	293	165	130	120	444	254	201	158	628	344	272
	2	39	61	41	33	59	117	80	64	82	193	128	102	119	287	194	155	153	400	272	218
	5	52	56	39	31	76	111	76	61	105	185	122	98	148	277	186	149	190	388	261	209
	10	NR	NR	34	27	97	100	68	53	132	171	112	87	188	261	171	133	237	369	241	188
15	0	36	93	57	49	56	190	111	95	80	325	186	160	116	499	283	243	153	713	388	334
	2	38	69	47	40	57	136	93	80	80	225	149	128	115	337	224	193	148	473	314	270
	5	51	63	44	37	75	128	86	73	102	216	140	119	144	326	217	184	182	459	298	253
	10	NR	NR	39	33	95	116	79	67	128	201	131	111	182	308	203	173	228	438	284	241
	15	NR	NR	NR	NR	NR	NR	72	61	158	186	124	105	220	290	192	163	272	418	269	229
20	0	35	96	60	54	54	200	118	106	78	346	201	181	114	537	306	275	149	772	428	385
	2	37	74	50	45	56	148	99	89	78	248	165	149	113	375	248	223	144	528	344	310
	5	50	68	47	42	73	140	94	84	100	239	158	141	141	363	239	213	178	514	334	297
	10	NR	NR	41	36	93	129	86	77	125	223	146	130	177	344	224	199	222	491	316	281
	15	NR	NR	NR	NR	NR	NR	80	71	155	208	136	121	216	325	210	187	264	469	301	268
	20	NR	NR	NR	NR	NR	NR	NR	NR	186	192	126	112	254	306	196	174	309	448	285	254
30	0	34	99	63	59	53	211	127	118	76	372	219	204	110	584	334	311	144	849	472	439
	2	37	80	56	52	55	164	111	103	76	281	183	170	109	429	279	259	139	610	392	365
	5	49	74	52	48	72	157	106	99	98	271	173	161	136	417	271	252	171	595	382	355
	10	NR	NR	NR	NR	91	144	98	91	122	255	168	156	171	397	257	239	213	570	367	341
	15	NR	NR	NR	NR	115	131	NR	NR	151	239	157	146	208	377	242	225	255	547	349	325
	20	NR	NR	NR	NR	NR	NR	NR	NR	181	223	NR	NR	246	357	228	212	298	524	333	310
	30	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	389	477	305	284
50	0	33	99	66	63	51	213	133	126	73	394	230	219	105	629	361	343	138	928	515	489
	2	36	84	61	58	53	181	121	115	73	318	205	195	104	495	312	296	133	712	443	421
	5	48	80	NR	NR	70	174	117	111	94	308	198	188	131	482	305	290	164	696	435	413
	10	NR	NR	NR	NR	89	160	NR	NR	118	292	186	177	162	461	292	277	203	671	420	399
	15	NR	NR	NR	NR	112	148	NR	NR	145	275	174	165	199	441	280	266	244	646	405	385
	20	NR	NR	NR	NR	NR	NR	NR	NR	176	257	NR	NR	236	420	267	254	285	622	389	370
	30	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	315	376	NR	NR	373	573	NR	NR
100	0	NR	NR	NR	NR	49	214	NR	NR	69	403	NR	NR	100	659	395	375	131	991	555	527
	2	NR	NR	NR	NR	51	192	NR	NR	70	351	NR	NR	98	563	373	354	125	828	508	483
	5	NR	NR	NR	NR	67	186	NR	NR	90	342	NR	NR	125	551	366	348	156	813	501	476
	10	NR	NR	NR	NR	85	175	NR	NR	113	324	NR	NR	153	532	354	336	191	789	486	462
	15	NR	NR	NR	NR	132	162	NR	NR	138	310	NR	NR	188	511	343	326	230	764	473	449
	20	NR	NR	NR	NR	NR	NR	NR	NR	168	295	NR	NR	224	487	NR	NR	270	739	458	435
	30	NR	NR	NR	NR	NR	NR	NR	NR	231	264	NR	NR	301	448	NR	NR	355	685	NR	NR
	50	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	540	584	NR	NR

Table C.2 (Continued)

Height H (ft)	Lateral L (ft)	Vent and vent connector diameter - D (in)															
		8				9				10				12			
		Appliance input rating in thousands of Btuh															
		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT	
Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP		
6	0	211	695	369	229	267	894	469	291	371	1118	569	353	537	1639	849	526
	2	201	423	284	173	251	541	368	224	347	673	453	276	498	979	648	395
	4	237	416	277	163	295	533	360	212	409	664	443	261	584	971	638	376
	6	263	409	271	160	327	526	352	208	449	656	433	255	638	962	627	370
8	0	206	777	414	302	258	1002	536	391	360	1257	658	480	521	1852	967	706
	2	197	482	321	234	246	617	417	304	339	768	513	374	486	1120	743	542
	5	245	470	311	221	305	604	404	287	418	754	500	355	598	1104	730	518
	8	280	458	300	213	344	591	392	278	470	740	486	345	665	1089	715	508
10	0	202	844	449	355	253	1093	584	461	351	1373	718	567	507	2031	1057	835
	2	193	531	354	283	242	681	456	365	332	849	559	447	475	1242	848	678
	5	241	518	344	275	299	667	443	354	409	834	544	435	584	1224	825	660
	10	296	497	325	254	363	643	423	330	492	808	520	406	688	1194	788	615
15	0	195	966	523	450	244	1259	681	586	336	1591	838	721	488	2374	1237	1064
	2	187	631	413	355	232	812	543	467	319	1015	673	579	457	1491	983	845
	5	231	616	400	340	287	795	526	447	392	997	657	558	562	1469	963	819
	10	284	592	381	324	349	768	501	426	470	966	628	534	664	1433	928	789
	15	334	568	367	312	404	742	484	411	540	937	601	511	750	1399	894	760
20	0	190	1053	573	516	238	1379	750	675	326	1751	927	834	473	2631	1346	1211
	2	182	708	468	421	227	914	611	550	309	1146	754	679	443	1689	1098	988
	5	224	692	457	407	279	896	596	530	381	1126	734	653	547	1665	1074	956
	10	277	666	437	389	339	866	570	507	457	1092	702	625	646	1626	1037	923
	15	325	640	419	373	393	838	549	489	526	1060	677	603	730	1587	1005	894
	20	374	616	400	356	448	810	526	468	592	1028	651	579	808	1550	973	866
30	0	184	1168	647	602	229	1542	852	792	312	1971	1056	982	454	2996	1545	1437
	2	175	823	533	496	219	1069	698	649	296	1346	863	803	424	1999	1308	1216
	5	215	806	521	485	269	1049	684	636	366	1324	846	787	524	1971	1283	1193
	10	265	777	501	466	327	1017	662	616	440	1287	821	764	620	1927	1243	1156
	15	312	750	481	447	379	985	638	593	507	1251	794	738	702	1884	1205	1121
	20	360	723	461	429	433	955	615	572	570	1216	768	714	780	1841	1166	1084
	30	461	670	426	396	541	895	574	534	704	1147	720	670	937	1759	1101	1024
50	0	176	1292	704	669	220	1724	948	901	295	2223	1189	1130	428	3432	1818	1727
	2	168	971	613	582	209	1273	811	770	280	1615	1007	957	401	2426	1509	1434
	5	204	953	602	572	257	1252	795	755	347	1591	991	941	496	2396	1490	1416
	10	253	923	583	554	313	1217	765	727	418	1551	963	915	589	2347	1455	1382
	15	299	894	562	534	363	1183	736	699	481	1512	934	887	668	2299	1421	1350
	20	345	866	543	516	415	1150	708	673	544	1473	906	861	741	2251	1387	1318
	30	442	809	502	477	521	1086	649	617	674	1399	848	806	892	2159	1318	1252
100	0	166	1404	765	727	207	1900	1033	981	273	2479	1300	1235	395	3912	2042	1940
	2	158	1152	698	663	196	1532	933	886	259	1970	1168	1110	371	3021	1817	1726
	5	194	1134	688	654	240	1511	921	875	322	1945	1153	1095	460	2990	1796	1706
	10	238	1104	672	638	293	1477	902	857	389	1905	1133	1076	547	2938	1763	1675
	15	281	1075	656	623	342	1443	884	840	447	1865	1110	1055	618	2888	1730	1644
	20	325	1046	639	607	391	1410	864	821	507	1825	1087	1033	690	2838	1696	1611
	30	418	988	NR	NR	491	1343	824	783	631	1747	1041	989	834	2739	1627	1546
	50	617	866	NR	NR	711	1205	NR	NR	895	1591	NR	NR	1138	2547	1489	1415

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 (in)															
		3				4				5				6			
		Appliance input rating limits in thousands of Btuh															
		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT	
		Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP
6	1	22	37	26	16	35	66	46	28	46	106	72	44	58	164	104	63
	2	23	41	31	19	37	75	55	34	48	121	86	52	60	183	124	76
	3	24	44	35	21	38	81	62	38	49	132	96	59	62	199	139	85
8	1	22	40	27	19	35	72	48	34	49	114	76	54	64	176	109	77
	2	23	44	32	23	36	80	57	40	51	128	90	64	66	195	129	92
	3	24	47	36	26	37	87	64	45	53	139	101	72	67	210	145	103
10	1	22	43	28	22	34	78	50	39	49	123	78	61	65	189	113	88
	2	23	47	33	26	36	86	59	46	51	136	93	73	67	206	134	105
	3	24	50	37	29	37	92	67	52	52	146	104	81	69	220	150	117
15	1	21	50	30	26	33	89	53	45	47	142	83	71	64	220	120	102
	2	22	53	35	30	35	96	63	54	49	153	99	84	66	235	142	121
	3	24	55	40	34	36	102	71	60	51	163	111	94	68	248	160	136
20	1	21	54	31	28	33	99	56	50	46	157	87	78	62	246	125	113
	2	22	57	37	33	34	105	66	59	48	167	104	94	64	259	149	134
	3	23	60	42	38	35	110	74	67	50	176	116	104	66	271	168	151
30	1	20	62	33	31	31	113	59	55	45	181	93	86	60	288	134	125
	2	21	64	39	36	33	118	70	65	47	190	110	102	62	299	158	147
	3	22	66	44	41	34	123	79	73	48	198	124	115	64	309	178	166
50	1	19	71	35	33	30	133	64	61	43	216	101	96	57	349	145	138
	2	21	73	43	41	32	137	76	72	45	223	119	113	59	358	172	163
	3	22	75	48	46	33	141	86	82	46	229	134	127	61	366	194	184
100	1	18	82	37	36	28	158	66	65	40	262	104	102	53	442	150	147
	2	19	83	44	43	30	161	79	77	42	267	123	121	55	447	178	174
	3	20	84	50	49	31	163	89	87	44	272	138	135	57	452	200	196

Common Vent Capacity

Vent height H (ft)	Common vent diameter - D (in)														
	4					5					6				
	Combined appliance input rating in thousands of Btuh														
	FAN +FAN	FAN +NAT	DP (F+N)	NAT +NAT	DP (N+N)	FAN +FAN	FAN +NAT	DP (F+N)	NAT +NAT	DP (N+N)	FAN +FAN	FAN +NAT	DP (F+N)	NAT +NAT	DP (N+N)
6	92	81	49	65	40	140	116	71	103	63	204	161	98	147	90
8	101	90	64	73	52	155	129	92	114	81	224	178	126	163	116
10	110	97	76	79	62	169	141	110	124	97	243	194	151	178	139
15	125	112	95	91	77	195	164	139	144	122	283	228	194	206	175
20	136	123	111	102	92	215	183	165	160	144	314	255	230	229	206
30	152	138	128	118	110	244	210	195	185	172	361	297	276	266	247
50	167	153	147	134	129	279	244	234	214	205	421	353	339	310	298
100	175	163	160	NR	NR	311	277	271	NR	NR	489	421	413	NR	NR

Table C.3 (Continued)

Vent height H (ft)	Vent connector rise R (ft)	Vent connector diameter - D (in)															
		7				8				9				10			
		Appliance input rating limits in thousands of Btuh															
		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT	
		Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP
6	1	77	225	142	87	92	296	185	113	109	376	237	145	128	466	289	176
	2	79	253	168	102	95	333	220	134	112	424	282	172	131	526	345	210
	3	82	275	189	115	97	363	248	151	114	463	317	193	134	575	386	235
8	1	84	243	148	105	100	320	194	138	118	408	248	176	138	507	303	215
	2	86	269	175	124	103	356	230	163	121	454	294	209	141	564	358	254
	3	88	290	198	141	105	384	258	183	123	492	330	234	143	612	402	285
10	1	89	257	154	120	106	341	200	156	125	436	257	200	146	542	314	245
	2	91	282	182	142	109	374	238	186	128	479	305	238	149	596	372	290
	3	94	303	205	160	111	402	268	209	131	515	342	267	152	642	417	325
15	1	88	298	163	139	110	389	214	182	134	493	273	232	162	609	333	283
	2	91	320	193	164	112	419	253	215	137	532	323	275	165	658	394	335
	3	93	339	218	185	115	445	286	243	140	565	365	310	167	700	444	377
20	1	86	334	171	154	107	436	224	202	131	552	285	257	158	681	347	312
	2	89	354	202	182	110	463	265	239	134	587	339	305	161	725	414	373
	3	91	371	228	205	113	486	300	270	137	618	378	466	164	764	466	419
30	1	83	391	182	169	103	512	238	221	125	649	305	284	151	802	372	346
	2	85	408	215	200	105	535	282	262	129	679	360	335	155	840	439	408
	3	88	423	242	225	108	555	317	295	132	706	405	377	158	874	494	459
50	1	78	477	197	187	97	627	257	244	120	797	330	314	144	984	403	383
	2	81	490	234	222	100	645	306	291	123	820	392	372	148	1014	478	454
	3	83	502	263	250	103	661	343	326	126	842	441	419	151	1043	538	511
100	1	73	611	204	200	91	810	266	261	112	1038	341	334	135	1285	417	409
	2	75	619	242	237	94	822	316	310	115	1054	405	397	139	1306	494	484
	3	78	627	272	267	97	834	355	348	118	1069	455	446	142	1327	555	544

Common Vent Capacity

Vent height H (ft)	Common vent diameter - D (in)																			
	7					8					9					10				
	Combined appliance input rating in thousands of Btuh																			
	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP
+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	((F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)	
6	309	248	151	200	122	404	314	192	260	159	547	434	265	335	204	672	520	317	410	250
8	339	275	195	223	158	444	348	247	290	206	602	480	341	378	268	740	577	410	465	330
10	367	299	233	242	189	477	377	294	315	246	649	522	407	405	316	800	627	489	495	386
15	427	352	299	280	238	556	444	377	365	310	753	612	520	465	395	924	733	623	565	480
20	475	394	355	310	279	621	499	449	405	365	842	688	619	523	471	1035	826	743	640	576
30	547	459	427	360	335	720	585	544	470	437	979	808	751	605	563	1209	975	907	740	688
50	641	547	525	423	406	854	706	678	550	528	1164	977	938	705	677	1451	1188	1140	860	826
100	751	658	645	479	469	1025	873	856	625	613	1408	1215	1191	800	784	1784	1502	1472	975	956

Table C.3 (Continued)

Vent height H (ft)	Vent connector rise R (ft)	Vent connector diameter - D (in)															
		12				14				16				18			
		Appliance input rating limits in thousands of Btuh															
		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT	
		Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP
6	2	174	764	496	303	223	1046	653	398	281	1371	853	520	346	1772	1080	659
	4	180	897	616	376	230	1231	827	504	287	1617	1081	659	352	2069	1370	836
	6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8	2	186	822	516	366	238	1126	696	494	298	1478	910	646	365	1920	1150	817
	4	192	952	644	457	244	1307	884	628	305	1719	1150	817	372	2211	1460	1037
	6	198	1050	772	548	252	1445	1071	760	313	1902	1390	987	380	2434	1770	1257
10	2	196	870	536	418	249	1195	730	569	311	1570	955	745	379	2049	1205	940
	4	201	997	664	518	256	1371	924	721	318	1804	1205	940	387	2332	1535	1197
	6	207	1095	792	618	263	1509	1118	872	325	1989	1455	1135	395	2556	1865	1455
15	2	214	967	568	483	272	1334	790	672	336	1760	1030	876	408	2317	1305	1109
	4	221	1076	712	605	279	1499	1006	855	344	1978	1320	1122	416	2579	1665	1415
	6	228	1181	856	728	286	1632	1222	1039	351	2157	1610	1369	424	2796	2025	1721
20	2	223	1051	596	536	291	1443	840	756	357	1911	1095	986	430	2533	1385	1247
	4	230	1162	748	673	298	1597	1064	958	365	2116	1395	1256	438	2778	1765	1589
	6	237	1253	900	810	307	1726	1288	1159	373	2287	1695	1526	450	2984	2145	1931
30	2	216	1217	632	588	286	1664	910	846	367	2183	1190	1107	461	2891	1540	1432
	4	223	1316	792	737	294	1802	1160	1079	376	2366	1510	1404	474	3110	1920	1786
	6	231	1400	952	885	303	1920	1410	1311	384	2524	1830	1702	485	3299	2340	2176
50	2	206	1479	689	655	273	2023	1007	957	350	2659	1315	1249	435	3548	1665	1582
	4	213	1561	860	817	281	2139	1291	1226	359	2814	1685	1601	447	3730	2135	2028
	6	221	1631	1031	979	290	2242	1575	1496	369	2951	2055	1952	461	3893	2605	2475
100	2	192	1923	712	698	254	2644	1050	1029	326	3490	1370	1343	402	4707	1740	1705
	4	200	1984	888	870	263	2731	1346	1319	336	3606	1760	1725	414	4842	2220	2176
	6	208	2035	1064	1043	272	2811	1642	1609	346	3714	2150	2107	426	4968	2700	2646

Common Vent Capacity

Vent height H (ft)	Common vent diameter - D (in)																			
	12					14					16					18				
	Combined appliance input rating in thousands of Btuh																			
	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP
+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)	
6	900	696	425	588	359	1284	990	604	815	497	1735	1336	815	1065	650	2253	1732	1057	1345	820
8	994	773	549	652	463	1423	1103	783	912	648	1927	1491	1059	1190	845	2507	1936	1375	1510	1072
10	1076	841	656	712	555	1542	1200	936	995	776	2093	1625	1268	1300	1014	2727	2113	1648	1645	1283
15	1247	986	838	825	701	1794	1410	1199	1158	984	2440	1910	1624	1510	1284	3184	2484	2111	1910	1624
20	1405	1116	1004	916	824	2006	1588	1429	1290	1161	2722	2147	1932	1690	1521	3561	2798	2518	2140	1926
30	1658	1327	1234	1025	953	2373	1892	1760	1525	1418	3220	2558	2379	1990	1851	4197	3326	3093	2520	2344
50	2024	1640	1574	1280	1229	2911	2347	2253	1863	1788	3964	3183	3056	2430	2333	5184	4149	3983	3075	2952
100	2569	2131	2088	1670	1637	3732	3076	3014	2450	2401	5125	4202	4118	3200	3136	6749	5509	5399	4050	3969

Table C.3 (Continued)

Vent height H (ft)	Vent connector rise R (ft)	Vent connector diameter - D (in)											
		20				22				24			
		Appliance input rating in thousands of Btuh											
		FAN		NAT		FAN		NAT		FAN		NAT	
		Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP
6	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
8	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	4	471	2737	1800	1278	560	3319	2180	1548	662	3957	2590	1839
	6	478	3018	2180	1548	568	3665	2640	1874	669	4373	3130	2222
10	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	4	486	2887	1890	1474	581	3502	2280	1778	686	4175	2710	2114
	6	494	3169	2290	1786	589	3849	2760	2153	694	4593	3270	2551
15	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	4	523	3197	2060	1751	624	3881	2490	2117	734	4631	2960	2516
	6	533	3470	2510	2134	634	4216	3030	2576	743	5035	3600	3060
20	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	4	554	3447	2180	1962	661	4190	2630	2367	772	5005	3130	2817
	6	567	3708	2650	2385	671	4511	3190	2871	785	5392	3790	3411
30	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	4	619	3840	2365	2199	728	4681	2860	2660	847	5606	3410	3171
	6	632	4080	2875	2674	741	4976	3480	3236	860	5961	4150	3860
50	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	4	580	4601	2633	2501	709	5569	3185	3026	851	6633	3790	3601
	6	594	4808	3208	3048	724	5826	3885	3691	867	6943	4620	4389
100	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	4	523	5982	2750	2695	639	7254	3330	3263	769	8650	3950	3871
	6	539	6143	3350	3283	654	7453	4070	3989	786	8892	4810	4714

Common Vent Capacity

Vent height H (ft)	Common vent diameter - D (in)														
	20					22					24				
	Combined appliance input rating in thousands of Btuh														
	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP
+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)	
6	2838	2180	1330	1660	1013	3488	2677	1633	1970	1202	4206	3226	1968	2390	1458
8	3162	2439	1732	1860	1321	3890	2998	2129	2200	1562	4695	3616	2567	2680	1903
10	3444	2665	2079	2030	1583	4241	3278	2557	2400	1872	5123	3957	3086	2920	2278
15	4026	3133	2663	2360	2006	4971	3862	3283	2790	2372	6016	4670	3970	3400	2890
20	4548	3552	3197	2640	2376	5573	4352	3917	3120	2808	6749	5261	4735	3800	3420
30	5303	4193	3899	3110	2892	6539	5157	4796	3680	3422	7940	6247	5810	4480	4166
50	6567	5240	5030	3800	3648	8116	6458	6200	4500	4320	9837	7813	7500	5475	5256
100	8597	6986	6846	5000	4900	10681	8648	8475	5920	5802	13004	10499	10289	7200	7056

Table C.4

**Capacity of Type B Double-Wall Vents with Single-Wall Vent Connectors
Serving Two or More Category I Appliances**

Vent Connector Capacity

Vent height H (ft)	Vent connector rise R (ft)	Vent connector diameter - D (in)																			
		3				4				5				6				7			
		Appliance input rating limits in thousands of Btuh																			
		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT	
		Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP
6	1	NR	NR	26	16	NR	NR	46	28	NR	NR	71	43	NR	NR	102	62	207	223	140	85
	2	NR	NR	31	19	NR	NR	55	34	NR	NR	85	52	168	182	123	75	215	251	167	102
	3	NR	NR	34	21	NR	NR	62	38	121	131	95	58	174	198	138	84	222	273	188	115
15	1	NR	NR	29	25	79	87	52	44	116	138	81	69	177	214	116	99	238	291	158	134
	2	NR	NR	34	29	83	94	62	53	121	150	97	82	185	230	138	117	246	314	189	161
	3	NR	NR	39	33	87	100	70	60	127	160	109	93	193	243	157	133	255	333	215	183
30	1	47	60	31	29	77	110	57	53	113	175	89	83	169	278	129	120	226	380	175	163
	2	50	62	37	34	81	115	67	62	117	185	106	99	177	290	152	141	236	397	208	193
	3	54	64	42	39	85	119	76	71	122	193	120	112	185	300	172	160	244	412	235	219
50	1	46	69	33	32	75	128	60	58	109	207	96	93	162	336	137	133	217	460	188	182
	2	49	71	40	39	79	132	72	70	114	215	113	110	170	345	164	159	226	473	223	216
	3	53	72	45	44	83	136	82	80	119	221	128	124	178	353	186	180	235	486	252	244

Common Vent Capacity

Vent height H (ft)	Common vent diameter - D (in)																			
	Common vent diameter - D (in)																			
	4					5					6					7				
	Combined appliance input rating in thousands of Btuh																			
	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP
+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)	
6	89	78	48	64	39	136	113	69	100	61	200	158	96	144	88	304	244	149	196	120
8	98	87	62	71	50	151	126	89	112	80	218	173	123	159	113	331	269	191	218	155
10	106	94	73	76	59	163	137	107	120	94	237	189	147	174	136	357	292	228	236	184
15	121	108	92	88	75	189	159	135	140	119	275	221	188	200	170	416	343	292	274	233
20	131	118	106	98	88	208	177	159	155	140	305	247	222	223	201	463	383	345	302	272
30	145	132	123	113	105	236	202	188	179	166	350	286	266	257	239	533	446	415	349	325
50	159	145	139	128	123	268	233	224	204	196	406	337	324	296	284	622	529	508	410	394

Table C.4 (Continued)

Vent Connector Capacity

Vent height H (ft)	Vent connecto r rise R (ft)	Vent connector diameter - D (in)											
		8				9				10			
		Appliance input rating limits in thousands of Btuh											
		FAN		NAT		FAN		NAT		FAN		NAT	
		Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP
6	1	262	293	183	112	325	373	234	143	447	463	286	174
	2	271	331	219	134	334	422	281	171	458	524	344	210
	3	279	361	247	151	344	462	316	193	468	574	385	235
15	1	312	380	208	177	397	482	266	226	556	596	324	275
	2	321	411	248	211	407	522	317	269	568	646	387	329
	3	331	438	281	239	418	557	360	306	579	690	437	371
30	1	296	497	230	214	378	630	294	273	528	779	358	333
	2	307	521	274	255	389	662	349	325	541	819	425	395
	3	316	542	309	287	400	690	394	366	555	855	482	448
50	1	284	604	245	238	364	768	314	305	507	951	384	372
	2	294	623	293	284	376	793	375	364	520	983	458	444
	3	304	640	331	321	387	816	424	411	535	1013	518	502

Common Vent Capacity

Vent height H (ft)	Common vent diameter - D (in)														
	8					9					10				
	Combined appliance input rating in thousands of Btuh														
	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP
	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)
6	398	310	189	257	157	541	429	262	332	203	665	515	314	407	248
8	436	342	243	285	202	592	473	336	373	265	730	569	404	460	327
10	467	369	288	309	241	638	512	399	398	310	787	617	481	487	380
15	544	434	369	357	303	738	599	509	456	388	905	718	610	553	470
20	606	487	438	395	356	824	673	606	512	461	1013	808	727	626	563
30	703	570	530	459	427	958	790	735	593	551	1183	952	885	723	672
50	833	686	659	535	514	1139	954	916	689	661	1418	1157	1111	838	804

Table C.5																					
Capacity of Tile-Lined Masonry Chimneys with Type B Double-Wall Vent Connectors Serving a Single Category I Appliance																					
Height H (ft)	Lateral L (ft)	Vent connector diameter - D (in)																			
		To be used with chimney areas within the size limits at bottom																			
		3				4				5				6				7			
		Appliance input rating in thousands of Btuh																			
		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT	
Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP		
6	2	N/A	N/A	28	17	N/A	N/A	52	31	N/A	N/A	86	51	N/A	N/A	130	77	N/A	N/A	180	106
	5	N/A	N/A	25*	15*	N/A	N/A	49	29	N/A	N/A	82	48	N/A	N/A	117	69	N/A	N/A	165	97
10	2	N/A	N/A	31	23	N/A	N/A	61	45	N/A	N/A	103	75	N/A	N/A	162	118	N/A	N/A	221	161
	5	N/A	N/A	28*	20*	N/A	N/A	57	42	N/A	N/A	96	70	N/A	N/A	148	108	N/A	N/A	204	149
	10	N/A	N/A	25*	18*	N/A	N/A	50*	36*	N/A	N/A	87	62	N/A	N/A	139	99	N/A	N/A	181	129
15	2	N/A	N/A	35*	30*	N/A	N/A	67	58	N/A	N/A	114	98	N/A	N/A	179	154	N/A	N/A	250	215
	5	N/A	N/A	33*	28*	N/A	N/A	62	53	N/A	N/A	107	92	N/A	N/A	164	141	N/A	N/A	231	199
	10	N/A	N/A	28*	24*	N/A	N/A	55*	47*	N/A	N/A	97	82	N/A	N/A	153	130	N/A	N/A	216	184
	15	N/A	N/A	NR	NR	N/A	N/A	48*	41*	N/A	N/A	89*	76*	N/A	N/A	141	120	N/A	N/A	201	171
20	2	N/A	N/A	38*	34*	N/A	N/A	74	67	N/A	N/A	124	112	N/A	N/A	201	181	N/A	N/A	274	247
	5	N/A	N/A	36*	32*	N/A	N/A	68*	61*	N/A	N/A	116	104	N/A	N/A	184	166	N/A	N/A	254	229
	10	N/A	N/A	NR	NR	N/A	N/A	60*	53*	N/A	N/A	107*	95*	N/A	N/A	172	153	N/A	N/A	237	211
	15	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	97*	86*	N/A	N/A	159	142	N/A	N/A	220	196
	20	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	83*	74*	N/A	N/A	148*	132*	N/A	N/A	206	183
30	2	N/A	N/A	41*	38*	N/A	N/A	82*	76*	N/A	N/A	137	127	N/A	N/A	216	201	N/A	N/A	303	282
	5	N/A	N/A	NR	NR	N/A	N/A	76*	71*	N/A	N/A	128*	119*	N/A	N/A	198	184	N/A	N/A	281	261
	10	N/A	N/A	NR	NR	N/A	N/A	67*	62*	N/A	N/A	115*	107*	N/A	N/A	184*	171*	N/A	N/A	263	245
	15	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	107*	100*	N/A	N/A	171*	159*	N/A	N/A	243*	226*
	20	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	91*	85*	N/A	N/A	159*	148*	N/A	N/A	227*	211*
	30	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	188*	175*
50	2	N/A	N/A	NR	NR	N/A	N/A	92*	87*	N/A	N/A	161*	153*	N/A	N/A	251*	238*	N/A	N/A	351*	333*
	5	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	151*	143*	N/A	N/A	230*	219*	N/A	N/A	323*	307*
	10	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	138*	131*	N/A	N/A	215*	204*	N/A	N/A	304*	289*
	15	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	127*	121*	N/A	N/A	199*	189*	N/A	N/A	282*	268*
	20	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	185*	176*	N/A	N/A	264*	251*
	30	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	NR	NR
Minimum internal area of chimney in ²		12				19				28				38				50			
Maximum internal area of chimney in ²		49				88				137				198				269			
* Possibility of continuous condensation.																					

Table C.5 (Continued)

Height H (ft)	Lateral L (ft)	Vent connector diameter - D (in) To be used with chimney areas within the size limits at bottom															
		8				9				10				12			
		Appliance input rating in thousands of Btuh															
		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT	
		Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP
6	2	N/A	N/A	247	146	N/A	N/A	320	189	N/A	N/A	401	237	N/A	N/A	581	343
	5	N/A	N/A	231	136	N/A	N/A	298	176	N/A	N/A	376	222	N/A	N/A	561	331
10	2	N/A	N/A	298	218	N/A	N/A	388	283	N/A	N/A	491	358	N/A	N/A	724	529
	5	N/A	N/A	277	202	N/A	N/A	365	266	N/A	N/A	466	340	N/A	N/A	712	520
	10	N/A	N/A	263	187	N/A	N/A	342	243	N/A	N/A	444	315	N/A	N/A	668	474
15	2	N/A	N/A	336	289	N/A	N/A	441	379	N/A	N/A	562	483	N/A	N/A	841	723
	5	N/A	N/A	313	269	N/A	N/A	416	358	N/A	N/A	533	458	N/A	N/A	828	712
	10	N/A	N/A	296	252	N/A	N/A	394	335	N/A	N/A	567	482	N/A	N/A	777	660
	15	N/A	N/A	281	239	N/A	N/A	375	319	N/A	N/A	485	412	N/A	N/A	742	631
20	2	N/A	N/A	375	338	N/A	N/A	491	442	N/A	N/A	627	564	N/A	N/A	953	858
	5	N/A	N/A	350	315	N/A	N/A	463	417	N/A	N/A	597	537	N/A	N/A	933	840
	10	N/A	N/A	332	295	N/A	N/A	440	392	N/A	N/A	566	504	N/A	N/A	879	782
	15	N/A	N/A	314	279	N/A	N/A	418	372	N/A	N/A	541	481	N/A	N/A	840	748
	20	N/A	N/A	296	263	N/A	N/A	397	353	N/A	N/A	513	457	N/A	N/A	807	718
30	2	N/A	N/A	421	392	N/A	N/A	558	519	N/A	N/A	717	667	N/A	N/A	1112	1034
	5	N/A	N/A	393	365	N/A	N/A	526	489	N/A	N/A	683	635	N/A	N/A	1094	1017
	10	N/A	N/A	373	347	N/A	N/A	500	465	N/A	N/A	648	603	N/A	N/A	1025	953
	15	N/A	N/A	353	328	N/A	N/A	476	443	N/A	N/A	621	578	N/A	N/A	981	912
	20	N/A	N/A	332	309	N/A	N/A	450	419	N/A	N/A	592	551	N/A	N/A	940	874
	30	N/A	N/A	288*	268*	N/A	N/A	416	387	N/A	N/A	555	516	N/A	N/A	877	816
50	2	N/A	N/A	477	453	N/A	N/A	633	601	N/A	N/A	812	771	N/A	N/A	1243	1180
	5	N/A	N/A	445	423	N/A	N/A	596	566	N/A	N/A	774	735	N/A	N/A	1225	1164
	10	N/A	N/A	424*	403*	N/A	N/A	567	539	N/A	N/A	733	696	N/A	N/A	1147	1090
	15	N/A	N/A	400*	380*	N/A	N/A	539*	512*	N/A	N/A	702	667	N/A	N/A	1099	1044
	20	N/A	N/A	376*	357*	N/A	N/A	511*	485*	N/A	N/A	669*	636*	N/A	N/A	1050	998
	30	N/A	N/A	327*	311*	N/A	N/A	468*	445*	N/A	N/A	623*	592*	N/A	N/A	984	935
Minimum internal area of chimney in ²		63				78				95				132			
Maximum internal area of chimney in ²		352				445				550				792			
* Possibility of continuous condensation.																	

Table C.6

**Capacity of Tile-Lined Masonry Chimneys with Single-Wall Vent Connectors
Serving a Single Category I Appliance**

Height H (ft)	Lateral L (ft)	Vent connector diameter - D (in)																			
		To be used with chimney areas within the size limits at bottom																			
		3				4				5				6				7			
		Appliance input rating in thousands of Btuh																			
		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT	
Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP		
6	2	N/A	N/A	28	17	N/A	N/A	52	31	N/A	N/A	86	51	N/A	N/A	130	77	N/A	N/A	180	106
	5	N/A	N/A	25*	15*	N/A	N/A	48	28	N/A	N/A	81	48	N/A	N/A	116	68	N/A	N/A	164	97
10	2	N/A	N/A	31	23	N/A	N/A	61	45	N/A	N/A	102	74	N/A	N/A	161	118	N/A	N/A	220	161
	5	N/A	N/A	28*	20*	N/A	N/A	56	41	N/A	N/A	95	69	N/A	N/A	147	107	N/A	N/A	203	148
	10	N/A	N/A	24*	17*	N/A	N/A	49*	35*	N/A	N/A	86	61	N/A	N/A	137	97	N/A	N/A	189	134
15	2	N/A	N/A	35*	30*	N/A	N/A	67	58	N/A	N/A	113	97	N/A	N/A	178	153	N/A	N/A	249	214
	5	N/A	N/A	32*	28*	N/A	N/A	61	52	N/A	N/A	106	91	N/A	N/A	163	140	N/A	N/A	230	198
	10	N/A	N/A	27*	23*	N/A	N/A	54*	46*	N/A	N/A	96	82	N/A	N/A	151	128	N/A	N/A	214	182
	15	N/A	N/A	NR	NR	N/A	N/A	46*	39*	N/A	N/A	87*	74*	N/A	N/A	138	117	N/A	N/A	198	168
20	2	N/A	N/A	38*	34*	N/A	N/A	73	66	N/A	N/A	123	111	N/A	N/A	200	180	N/A	N/A	273	246
	5	N/A	N/A	35*	32*	N/A	N/A	67*	60*	N/A	N/A	115	104	N/A	N/A	183	165	N/A	N/A	252	227
	10	N/A	N/A	NR	NR	N/A	N/A	59*	53*	N/A	N/A	105*	93*	N/A	N/A	170	151	N/A	N/A	235	209
	15	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	95*	85*	N/A	N/A	156	139	N/A	N/A	217	193
	20	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	80*	71*	N/A	N/A	144*	128*	N/A	N/A	202	180
30	2	N/A	N/A	41*	38*	N/A	N/A	81*	75*	N/A	N/A	136	126	N/A	N/A	215	200	N/A	N/A	302	281
	5	N/A	N/A	NR	NR	N/A	N/A	75*	70*	N/A	N/A	127*	118*	N/A	N/A	196	182	N/A	N/A	279	259
	10	N/A	N/A	NR	NR	N/A	N/A	66*	61*	N/A	N/A	113*	105*	N/A	N/A	182*	169*	N/A	N/A	260	242
	15	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	105*	98*	N/A	N/A	168*	156*	N/A	N/A	240*	223*
	20	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	88*	82*	N/A	N/A	155*	144*	N/A	N/A	223*	207*
	30	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	182*	169*
50	2	N/A	N/A	NR	NR	N/A	N/A	91*	86*	N/A	N/A	160*	152*	N/A	N/A	250*	238*	N/A	N/A	350*	333*
	5	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	140*	133*	N/A	N/A	228*	217*	N/A	N/A	321*	305*
	10	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	136*	129*	N/A	N/A	212*	201*	N/A	N/A	301*	286*
	15	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	124*	118*	N/A	N/A	195*	185*	N/A	N/A	278*	264*
	20	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	180*	171*	N/A	N/A	258*	245*
	30	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	NR	NR	N/A	N/A	NR	NR
Minimum internal area of chimney in ²		12				19				28				38				50			
Maximum internal area of chimney in ²		49				88				137				198				269			

* Possibility of continuous condensation.

Table C.6 (Continued)

Height H (ft)	Lateral L (ft)	Vent connector diameter - D (in)															
		To be used with chimney areas within the size limits at bottom															
		8				9				10				12			
		Appliance input rating limits in thousands of Btuh															
		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT	
Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP		
6	2	N/A	N/A	247	146	N/A	N/A	319	188	N/A	N/A	400	236	N/A	N/A	580	342
	5	N/A	N/A	230	136	N/A	N/A	297	175	N/A	N/A	375	221	N/A	N/A	560	330
10	2	N/A	N/A	297	217	N/A	N/A	387	283	N/A	N/A	490	358	N/A	N/A	722	527
	5	N/A	N/A	276	201	N/A	N/A	364	266	N/A	N/A	465	339	N/A	N/A	710	518
	10	N/A	N/A	261	185	N/A	N/A	345	245	N/A	N/A	441	313	N/A	N/A	665	472
15	2	N/A	N/A	335	288	N/A	N/A	440	378	N/A	N/A	560	482	N/A	N/A	840	722
	5	N/A	N/A	312	268	N/A	N/A	414	356	N/A	N/A	531	457	N/A	N/A	825	710
	10	N/A	N/A	294	250	N/A	N/A	392	333	N/A	N/A	504	428	N/A	N/A	774	658
	15	N/A	N/A	278	236	N/A	N/A	372	316	N/A	N/A	481	409	N/A	N/A	738	627
20	2	N/A	N/A	374	337	N/A	N/A	490	441	N/A	N/A	625	563	N/A	N/A	950	855
	5	N/A	N/A	348	313	N/A	N/A	461	415	N/A	N/A	594	535	N/A	N/A	930	837
	10	N/A	N/A	330	294	N/A	N/A	437	389	N/A	N/A	562	500	N/A	N/A	875	779
	15	N/A	N/A	311	277	N/A	N/A	414	368	N/A	N/A	536	477	N/A	N/A	835	743
	20	N/A	N/A	292	260	N/A	N/A	392	349	N/A	N/A	510	454	N/A	N/A	800	712
30	2	N/A	N/A	420	391	N/A	N/A	556	517	N/A	N/A	715	665	N/A	N/A	1110	1032
	5	N/A	N/A	391	364	N/A	N/A	524	487	N/A	N/A	680	632	N/A	N/A	1090	1014
	10	N/A	N/A	370	344	N/A	N/A	496	461	N/A	N/A	644	599	N/A	N/A	1020	949
	15	N/A	N/A	349	325	N/A	N/A	471	438	N/A	N/A	615	572	N/A	N/A	975	907
	20	N/A	N/A	327	304	N/A	N/A	445	414	N/A	N/A	585	544	N/A	N/A	932	867
	30	N/A	N/A	281*	261*	N/A	N/A	408	379	N/A	N/A	544	506	N/A	N/A	865	804
50	2	N/A	N/A	475	451	N/A	N/A	631	599	N/A	N/A	810	770	N/A	N/A	1240	1178
	5	N/A	N/A	442	420	N/A	N/A	593	563	N/A	N/A	770	732	N/A	N/A	1220	1159
	10	N/A	N/A	420*	399*	N/A	N/A	562	534	N/A	N/A	728	692	N/A	N/A	1140	1083
	15	N/A	N/A	395*	375*	N/A	N/A	533*	506*	N/A	N/A	695	660	N/A	N/A	1090	1036
	20	N/A	N/A	370*	352*	N/A	N/A	504*	479*	N/A	N/A	660*	627*	N/A	N/A	1040	988
	30	N/A	N/A	318*	302*	N/A	N/A	458*	435*	N/A	N/A	610*	580*	N/A	N/A	970	922
Minimum internal area of chimney in ²		63				78				95				132			
Maximum internal area of chimney in ²		352				445				550				792			
* Possibility of continuous condensation.																	

Table C.7

**Capacity of Tile-Lined Masonry Chimneys with Type B Double-Wall Vent Connectors
Serving Two or More Category I Appliances**

Vent Connector Capacity

Vent height H (ft)	Vent connector rise R (ft)	Vent connector diameter - D (in)															
		3				4				5				6			
		Appliance input rating limits in thousands of Btuh															
		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT	
		Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP
6	1	24	NR	21	13	39	62	40	24	52	106	67	41	65	194	101	62
	2	26	43	28	17	41	79	52	32	53	133	85	52	67	230	124	76
	3	27	49	34	21	42	92	61	37	55	155	97	59	69	262	143	87
15	1	24	48	23	20	38	93	44	37	54	154	74	63	72	277	114	97
	2	25	55	31	26	39	105	55	47	56	174	89	76	74	299	134	114
	3	26	59	35	30	41	115	64	54	57	189	102	87	76	319	153	130
30	1	24	54	25	23	37	111	48	45	52	192	82	76	69	357	127	118
	2	25	60	32	30	38	122	58	54	54	208	95	88	72	376	145	135
	3	26	64	36	33	40	131	66	61	56	221	107	100	74	392	163	152
50	1	23	52	26	25	36	116	49	48	51	209	82	80	67	405	133	129
	2	24	59	31	30	37	127	58	56	53	225	96	93	70	421	152	147
	3	26	64	37	36	39	135	66	64	55	237	108	105	72	435	170	165

Common Vent Capacity

Vent height H (ft)	Minimum internal area of Chimney-A (in ²)																			
	12					19					28					38				
	Combined appliance input rating in thousands of Btuh																			
	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP
	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)
6	NR	74	45	25	15	NR	119	73	46	28	NR	178	109	71	43	NR	257	157	103	63
8	NR	80	57	28	20	NR	130	92	53	38	NR	193	137	82	58	NR	279	198	119	84
10	NR	84	66	31	24	NR	138	108	56	44	NR	207	161	90	70	NR	299	233	131	102
15	NR	90	77	36	31	NR	152	129	67	57	NR	233	198	106	90	NR	334	284	152	129
20	NR	92	83	41	37	NR	159	143	75	68	NR	250	225	122	110	NR	368	331	172	155
30	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	270	251	137	127	NR	404	376	198	184
50	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

Table C.7 (Continued)

Vent Connector Capacity

Vent height H (ft)	Vent connector rise R (ft)	Vent connector diameter - D (in)															
		7				8				9				10			
		Appliance input rating limits in thousands of Btuh															
		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT	
		Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP
6	1	87	274	141	86	104	370	201	123	124	479	253	154	145	599	319	195
	2	89	324	173	106	107	436	232	142	127	562	330	201	148	694	378	231
	3	91	369	203	124	109	491	270	165	129	633	349	213	151	795	439	268
15	1	100	384	174	148	125	511	229	195	153	658	297	252	184	824	375	319
	2	103	419	192	163	128	558	260	221	156	718	339	288	187	900	432	367
	3	105	448	215	183	131	597	292	248	159	760	382	325	190	960	486	413
30	1	96	504	187	174	119	680	255	237	145	883	337	313	175	1115	432	402
	2	99	531	209	194	122	715	287	267	149	928	378	352	179	1171	484	450
	3	101	554	233	217	125	746	317	295	152	968	418	389	182	1220	535	498
50	1	92	582	198	192	115	798	271	263	140	1049	362	351	168	1334	462	448
	2	95	604	222	215	118	827	304	295	143	1085	400	388	172	1379	510	495
	3	98	624	247	240	121	854	334	324	147	1118	439	426	176	1421	558	541

Common Vent Capacity

Vent height H (ft)	Minimum internal area of Chimney-A (in ²)																			
	50					63					78					113				
	Combined appliance input rating in thousands of Btuh																			
	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP
	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)
6	NR	351	214	143	87	NR	458	279	188	115	NR	582	355	246	150	NR	853	520	NR	NR
8	NR	384	273	163	116	NR	501	356	218	155	NR	636	452	278	197	NR	937	665	408	290
10	NR	409	319	177	138	NR	538	420	236	184	NR	686	535	302	236	NR	1010	788	454	354
15	NR	467	397	212	180	NR	611	519	283	241	NR	781	664	365	310	NR	1156	983	546	464
20	NR	508	457	243	219	NR	668	601	325	293	NR	858	772	419	377	NR	1286	1157	648	583
30	NR	564	525	278	259	NR	747	695	381	354	NR	969	901	496	461	NR	1373	1277	749	697
50	NR	620	595	328	315	NR	831	798	461	443	NR	1089	1045	606	582	NR	1692	1624	922	885

Table C.8

**Capacity of Tile-Lined Masonry Chimneys with Single-Wall Vent Connectors
Serving Two or More Category I Appliances**

Total vent height H (ft)	Vent connector rise R (ft)	Vent connector diameter - D (in)															
		3				4				5				6			
		Appliance input rating limits in thousands of Btuh															
		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT	
		Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP
6	1	NR	NR	21	14	NR	NR	39	25	NR	NR	66	43	179	191	100	65
	2	NR	NR	28	18	NR	NR	52	34	NR	NR	84	55	186	227	123	80
	3	NR	NR	34	22	NR	NR	61	40	134	153	97	63	193	258	142	92
15	1	NR	NR	23	20	NR	NR	43	37	129	151	73	62	199	271	112	95
	2	NR	NR	30	26	92	103	54	46	135	170	88	75	207	295	132	112
	3	NR	NR	34	29	96	112	63	54	141	185	101	86	215	315	151	128
30	1	NR	NR	24	23	86	108	47	45	126	187	80	76	193	347	124	118
	2	NR	NR	31	29	91	119	57	54	132	203	93	88	201	366	142	135
	3	NR	NR	35	33	95	127	65	62	138	216	105	100	209	381	160	152
50	1	NR	NR	25	24	85	113	48	46	124	204	80	76	188	392	130	124
	2	NR	NR	31	29	89	123	57	54	130	218	94	89	196	408	149	142
	3	NR	NR	35	33	94	131	65	62	136	231	106	101	205	422	167	159

Note: See Clause 7.12.8.

Common (Chimney) Capacity

Total vent height H (ft)	Common vent equivalent chimney diameter - D (in)																			
	4					5					6					7				
	Combined appliance input rating in thousands of Btuh																			
	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP
	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)
6	NR	73	44	25	15	NR	118	71	45	27	NR	176	106	71	43	NR	255	153	102	61
8	NR	79	58	28	20	NR	128	93	52	38	NR	190	139	81	59	NR	276	201	118	86
10	NR	83	66	31	25	NR	136	109	56	45	NR	205	164	89	71	NR	295	236	129	103
15	NR	88	75	36	31	NR	149	127	66	56	NR	230	196	105	89	NR	335	285	150	128
20	NR	90	80	40	36	NR	157	140	74	66	NR	247	220	120	107	NR	362	322	170	151
30	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	266	247	135	126	NR	398	370	195	181
50	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

Note: See Clause 7.12.8.

Table C.8 (Continued)

Total vent height H (ft)	Vent connector rise R (ft)	Vent connector diameter - D (in)															
		7				8				9				10			
		Appliance input rating limits in thousands of Btuh															
		FAN		NAT		FAN		NAT		FAN		NAT		FAN		NAT	
		Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP	Min	Max	Max	DP
6	1	231	271	140	91	292	366	200	130	362	474	252	164	499	594	283	184
	2	239	321	172	112	301	432	231	150	373	557	299	194	509	696	331	215
	3	247	365	202	131	309	491	269	175	381	634	348	226	519	793	375	244
15	1	268	376	171	145	349	502	225	191	445	646	291	247	623	808	360	306
	2	277	411	189	161	359	548	256	218	456	706	334	284	634	884	402	342
	3	286	439	213	181	368	586	289	246	466	755	378	321	646	945	437	371
30	1	259	492	183	174	338	665	250	238	430	864	330	314	600	1089	455	432
	2	269	518	205	195	348	699	282	268	442	908	372	353	613	1145	490	466
	3	277	540	229	218	358	729	312	296	452	946	412	391	626	1193	521	495
50	1	252	567	194	184	328	778	265	252	417	1022	355	337	582	1302	537	510
	2	262	588	218	207	339	806	298	283	429	1058	393	373	596	1346	567	539
	3	271	607	243	231	349	831	328	312	440	1090	431	409	610	1386	595	565

Note: See Clause 7.12.8.

Common (Chimney) Capacity

Total vent height H (ft)	Common vent equivalent chimney diameter - D (in)																			
	8					9					10					12				
	Combined appliance input rating in thousands of Btuh																			
	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP	FAN	FAN	DP	NAT	DP
	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)	+FAN	+NAT	(F+N)	+NAT	(N+N)
6	NR	348	209	142	85	NR	455	273	187	112	NR	579	347	245	147	NR	846	508	NR	NR
8	NR	390	285	162	118	NR	497	363	217	158	NR	633	462	277	202	NR	928	677	405	296
10	NR	405	324	175	140	NR	532	426	234	187	NR	680	544	300	240	NR	1000	800	450	360
15	NR	460	391	210	179	NR	602	512	280	238	NR	772	656	360	306	NR	1139	968	540	459
20	NR	503	448	240	214	NR	661	588	321	286	NR	849	756	415	369	NR	1264	1125	640	570
30	NR	558	519	275	256	NR	739	687	377	351	NR	957	890	490	456	NR	1447	1346	740	688
50	NR	612	581	325	309	NR	821	780	456	433	NR	1076	1022	600	570	NR	1672	1588	910	865

Note: See Clause 7.12.8.

Table C.9

Single-Wall Vent Connector Total Length Limits for Multiple Appliance Installations

Vent connector diameter (in)	3	4	5	6	7	8
Maximum vent connector length (ft)	5	6	8	10	11	12

Note: Double-wall vent connectors may exceed these values up to a limit of twice these specified values. However, when these values are exceeded using a Type B Vent, the capacity shall be reduced by 10%.

Table C.10
Masonry Chimney Liner Dimensions with Circular Equivalents

Nominal liner size (in)	Inside dimensions of liner (in)	Inside diameter or equivalent diameter (in)	Equivalent area (in ²)
4 x 8	2-1/2 x 6-1/2	4567	12.2
			19.6
			28.3
			38.3
8 x 8	6-3/4 x 6-3/4	7.48	42.7
			50.3
8 x 12	6-1/2 x 10-1/2	910	63.6
			70.5
12 x 12	9-3/4 x 9-3/4	10.411	83.3
			95
12 x 16	9-1/2 x 13-1/2	11.81214	107.5
			113.0
			153.9
16 x 16	13-1/4 x 13-1/4	14.515	162.9
			176.7
16 x 20	13 x 17	16.218	206.1
			254.4
20 x 20	16-3/4 x 16-3/4	18.22	260.2
			314.1
20 x 24	16-1/2 x 20-1/2	20.122	314.2
			380.1
24 x 24	20-1/4 x 20-1/4	22.124	380.1
			452.3
24 x 28	20-1/4 x 24-1/4	24.1	456.2
28 x 28	24-1/4 x 24-1/4	26.427	543.3
			572.5
30 x 30	25-1/2 x 25-1/2	27.93	607
			706.8
30 x 36	25-1/2 x 31-1/2	30.933	749.9
			855.3
36 x 36	31-1/2 x 31-1/2	34.436	929.4
			1017.9

Note: When liner sizes differ dimensionally from those shown in this Table, equivalent diameters may be determined from published tables for square and rectangular ducts of equivalent carrying capacity or by other engineering methods.

Appendix C

(Table C.1 shall be used when Type B vent is used for both the vent connector and the vertical vent.)

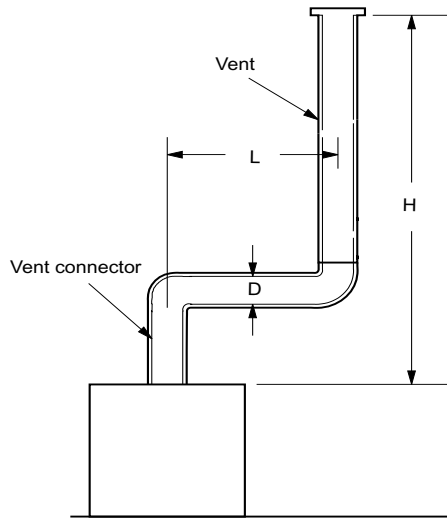


FIGURE C.1

(Table C.2 shall be used when a single-wall metal vent connector is attached to Type B vertical vent.)

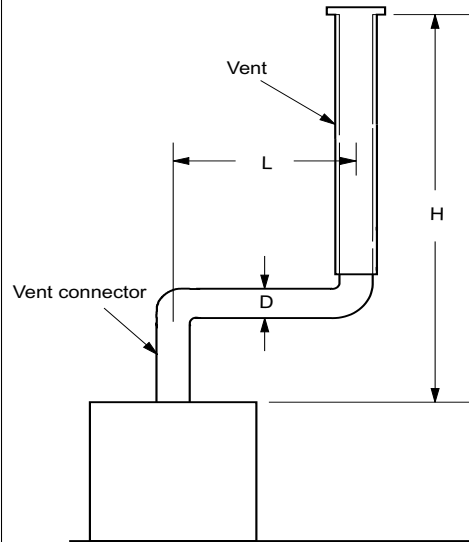


FIGURE C.2

(Table C.3 shall be used when Type B vent connectors are attached to a Type B common vent.)

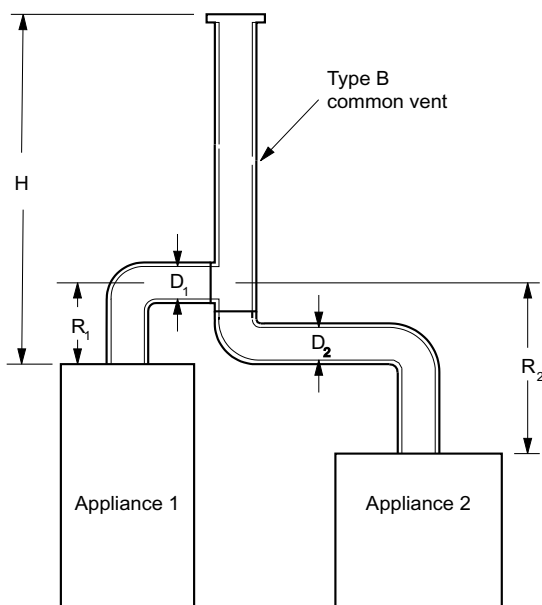


FIGURE C.3

(Table C.4 shall be used when single-wall metal vent connectors are attached to a Type B common vent.)

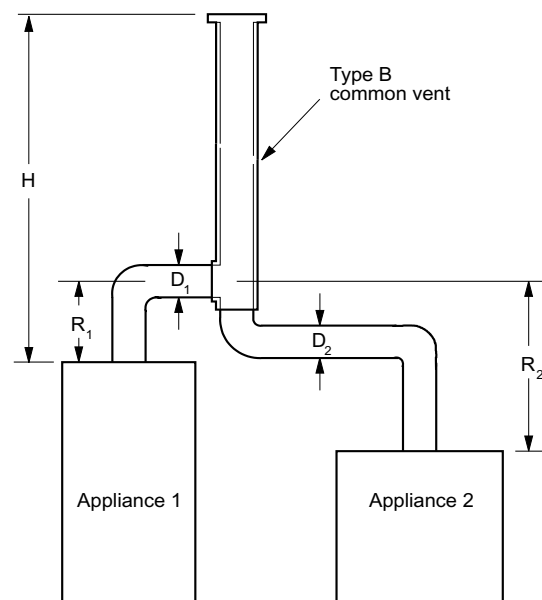


FIGURE C.4

Schematic Diagram Showing a Typical Manifolded Common Vent section "L" of the Vent Connector.
(See General Venting Requirements no. 4 in this Appendix.)

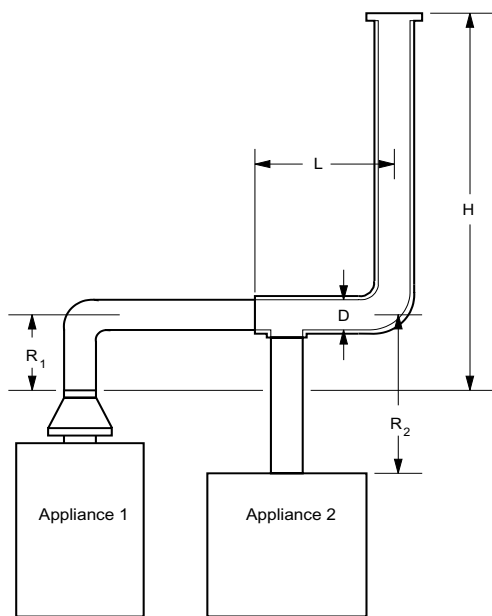


FIGURE C.5

Schematic Diagram Showing Offset in the Common Vent Section of the Vertical Vent.
(See General Venting Requirements no. 5 in this Appendix.)

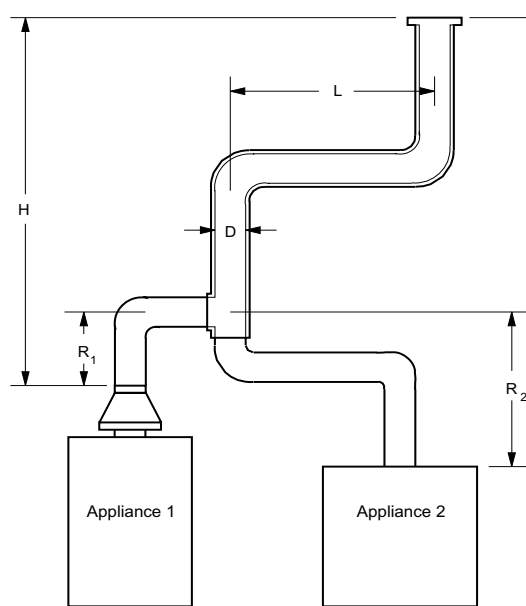


FIGURE C.6

(Table C.5 shall be used when a Type B double-wall vent connector is attached to a tile-lined masonry chimney.)

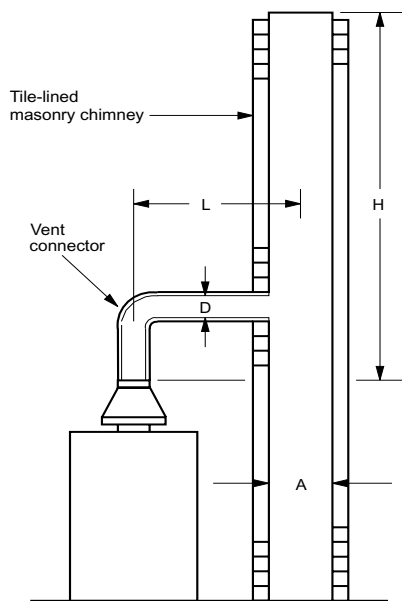


FIGURE C.7

(Table C.6 shall be used when a single-wall metal vent connector is attached to a tile-lined masonry chimney.)

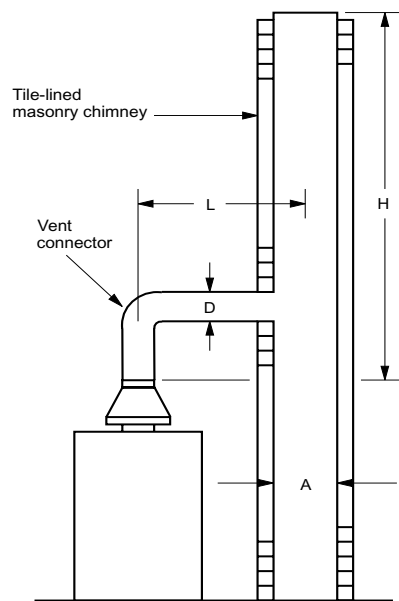


FIGURE C.8

(Table C.7 shall be used when Type B double-wall vent connectors are attached to a tile-lined masonry chimney.)

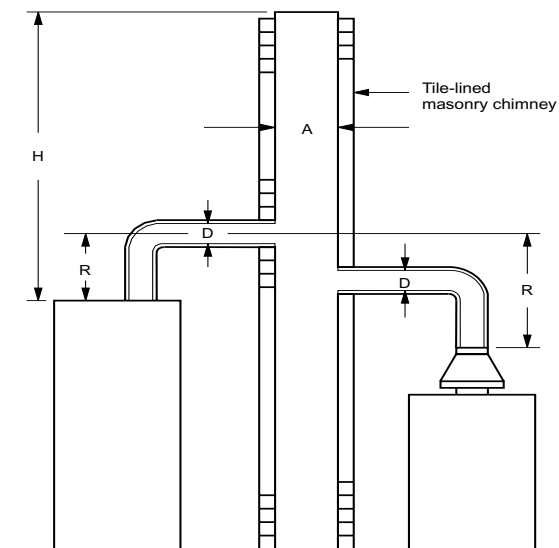


FIGURE C.9

(Table C.8 shall be used when single-wall vent connectors are attached to a tile-lined masonry chimney.)

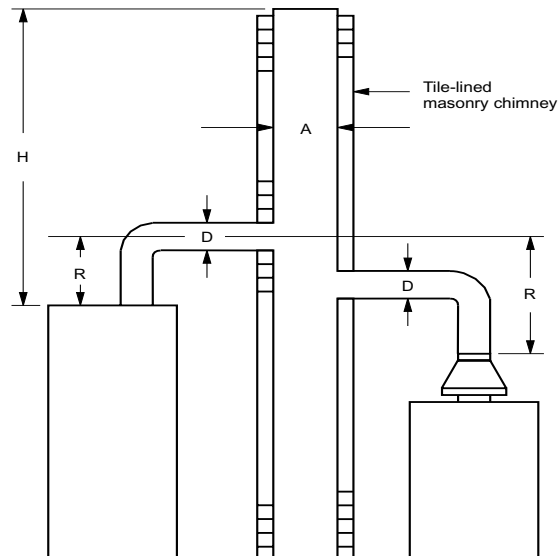


FIGURE C.10

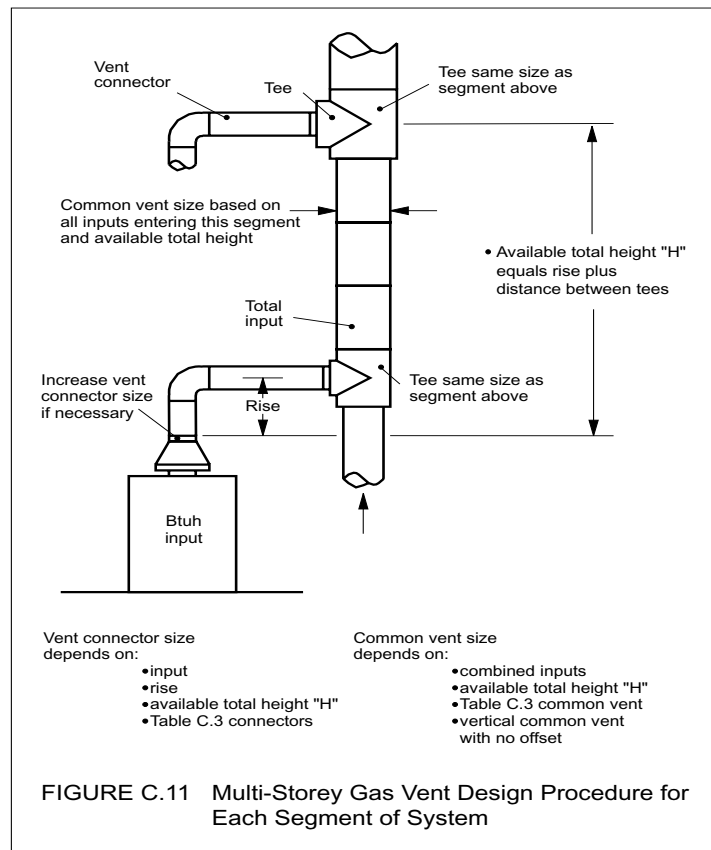
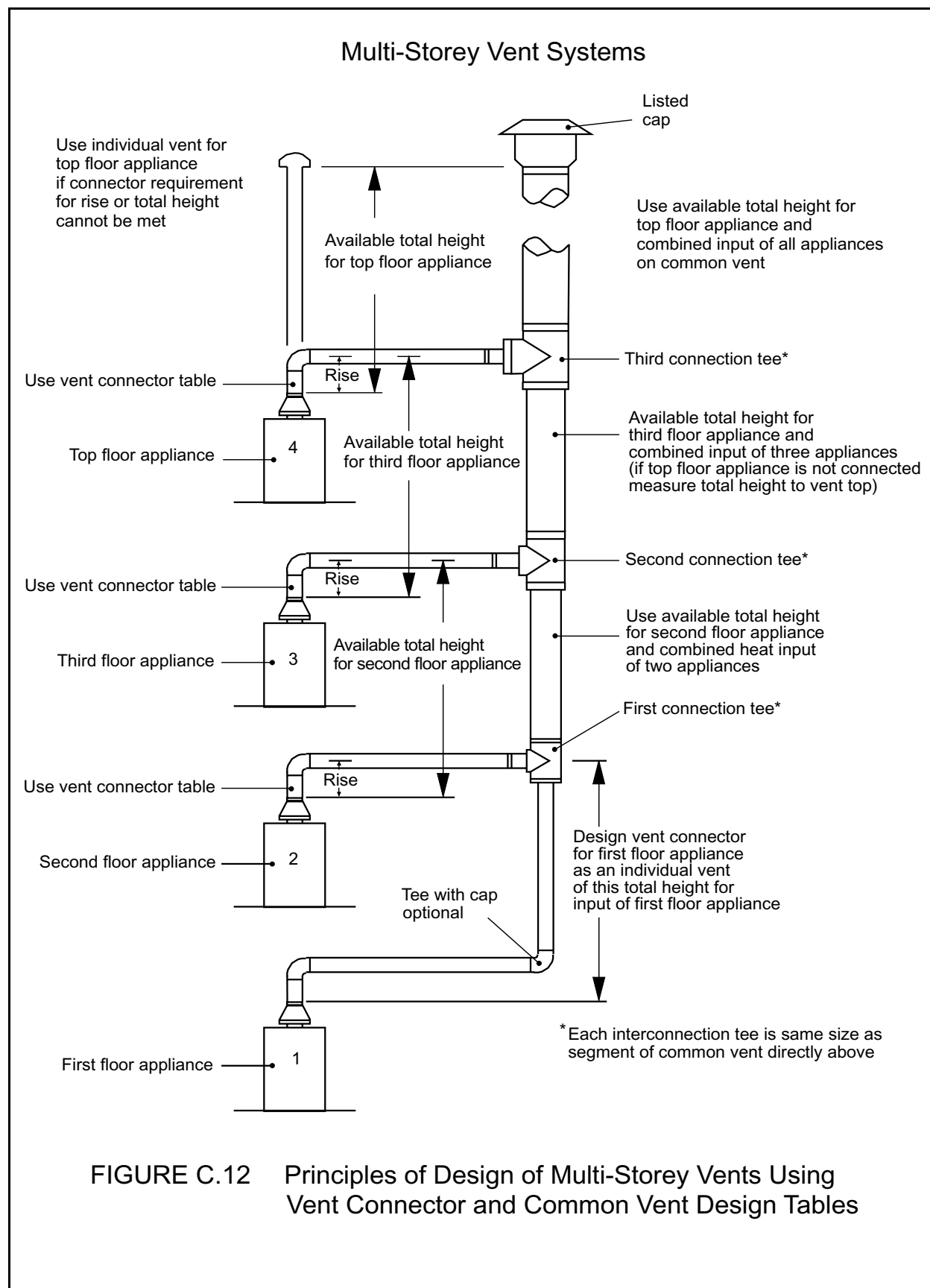


FIGURE C.11 Multi-Storey Gas Vent Design Procedure for Each Segment of System



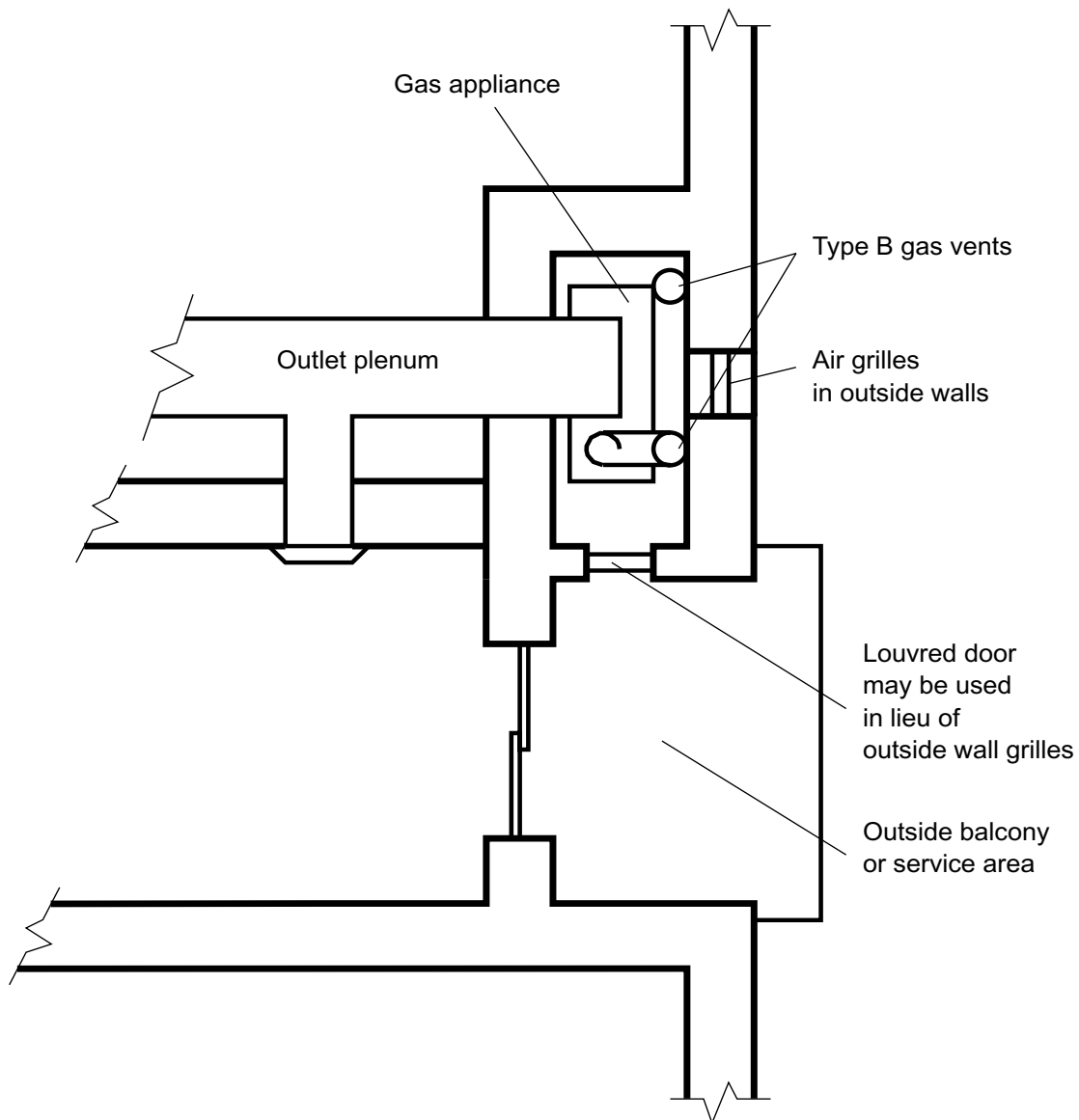


FIGURE C.13 Plan View of Practical Separation Method for Multi-Storey Venting

Vent Sizing Examples

The examples that follow are intended to illustrate typical applications of the *General Venting Requirements* and tables in Appendix C of the B149.1 Code. These have been summarized below for convenient reference.

SUMMARY OF HANDBOOK EXAMPLES	
Example 1	Fan-Assisted Appliance with Single-Wall Vent Connector to B Vent
Example 2	Draft Hood-Equipped Appliance with Single-Wall Vent Connector to B Vent
Example 3	Draft Hood-Equipped Appliance with Single-Wall Vent Connector to Tile-Lined Chimney
Example 4	Draft Hood-Equipped Appliance with Single-Wall Vent Connector to Certified Corrugated Liner
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
Example 7	Fan-Assisted and Draft Hood-Equipped Appliances with Type B Vent Connectors to Common B Vent
Example 8	Fan-Assisted and Draft Hood-Equipped Appliances with Type B Vent Connectors to Tile-Lined Chimney
Example 9	Fan-Assisted and Draft Hood-Equipped Appliances with Type B Vent Connectors to Certified Corrugated Liner
Example 10	Fan-Assisted and Draft Hood-Equipped Appliances with Type B Vent Connector Manifold to Common B vent
Example 11	Fan-Assisted and Draft Hood-Equipped Appliances with Single-Wall Vent Connectors to Common B vent with Offset
Example 12	Interpolating between Table Values

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

Suppose an installer has an 80 000 Btuh input fan-assisted appliance that must be installed using 10 ft of lateral connector attached to a 30 ft high Type B vent. Two 90° elbows are needed for the installation. Can a single-wall metal vent connector be used for this application?

Solution

Table C.2 refers to the use of single-wall metal vent connectors with Type B vent. In the first column find the row associated with a 30 ft height and a 10 ft lateral. Read across this row, looking at the "FAN Min" and "FAN Max" columns, to find that a 3 in diameter single-wall metal connector vent is not recommended. Moving to the next larger size single wall connector (4 in), we find that a 4 in diameter single-wall metal connector has a recommended minimum vent capacity of 91 000 Btuh and a recommended maximum vent capacity of 144 000 Btuh. The 80 000 Btuh fan-assisted appliance is outside the range, so we conclude that a 10 ft lateral single-wall metal vent connector cannot be used to vent this appliance.

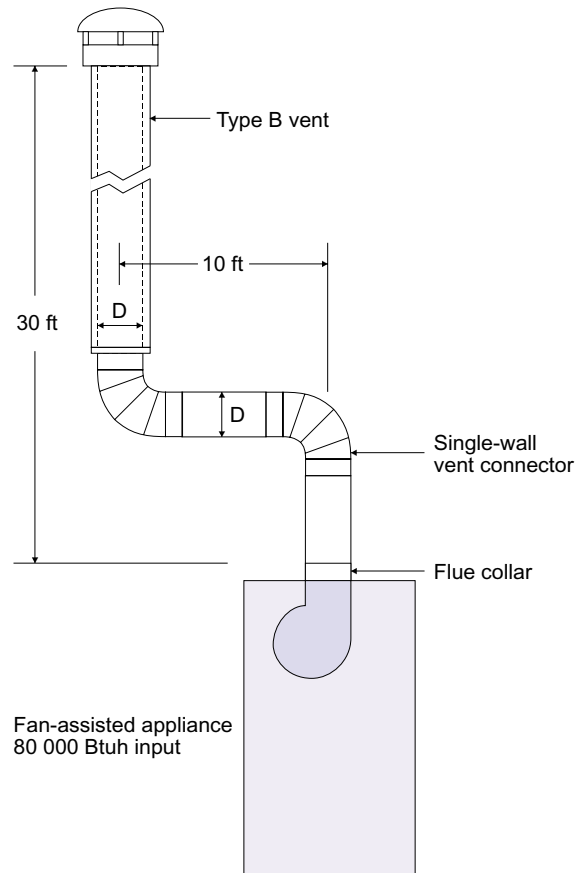
However, we see that if the 80 000 Btuh input appliance could be moved to within 5 ft of the vertical vent, then a 4 in single-wall metal connector could be used to vent the appliance.

Table C.2 shows the acceptable range of vent capacities for a 4 in vent with 5 ft of lateral to be between 72 000 Btuh and 157 000 Btuh.

If the appliance cannot be moved closer to the vertical vent, then Type B vent could be used as the connector material. In this case, Table C.1 shows that for a 30 ft high vent with 10 ft of lateral, the acceptable range of vent capacities for a 4 in diameter vent attached to a fan-assisted appliance is between 37 000 Btuh and 150 000 Btuh.

It should be noted that when using the tables for fan-assisted appliances, the total input connected to the venting system must always fall within the "Min" and "Max" values.

Using a larger vent diameter would lead to excessive condensation and corrosion in the vent. A smaller vent diameter would simply not provide adequate venting.



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

Suppose that an installer has a 120 000 Btuh input appliance with a 5 ft lateral vent connector that needs to be vented into a 10 ft high Type B vent system. What size vent should be used assuming

- (a) a 5 ft lateral single-wall metal vent connector is used with two 90° elbows;
- (b) a 5 ft lateral single-wall metal vent connector is used with three 90° elbows in the vent system; and
- (c) a 5 ft lateral single-wall metal vent connector is used with two 90° elbows located in a structure that is tight and that may experience depressurization of up to 5 Pa (0.02 in w.c.)?

Solution

Table C.2 should be used to solve this problem because single-wall metal vent connectors are being used with a Type B vent. Refer to Figure C.2 in Appendix C.

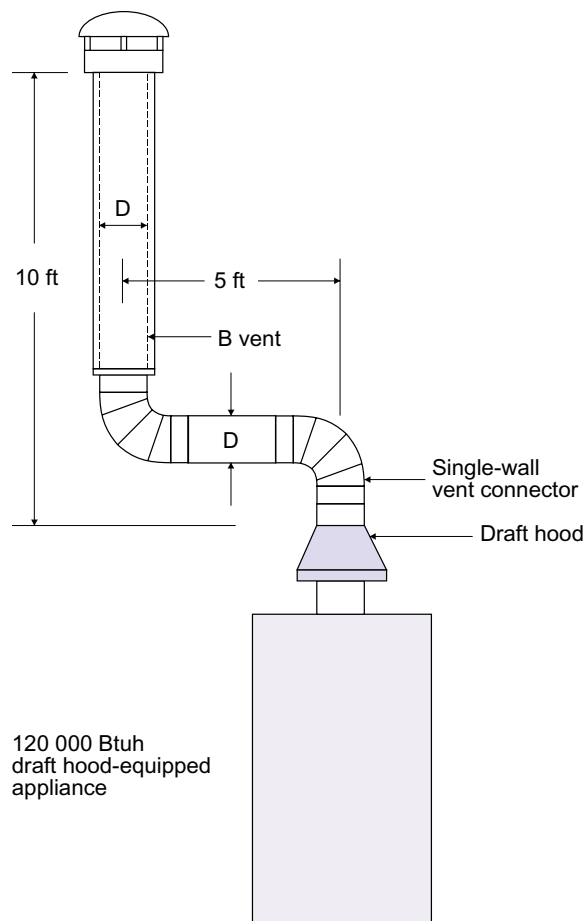
(a) Read down the first column in Table C.2 until the row associated with a 10 ft height and 5 ft lateral is found. Read across this row until a vent capacity greater than 120 000 Btuh is located in the column labelled "NAT Max" for Draft Hood-Equipped appliances. In this case, a 5 in diameter vent has a capacity of 122 000 Btuh and should be used.

(b) If three 90° elbows are used in the vent system, then the maximum vent capacity listed in the tables must be reduced by 10% (see General Venting Requirements no. 3). This implies that the 5 in diameter vent has an adjusted capacity of only 110 000 Btuh. In this case, the vent system must be increased to 6 in in diameter. See calculations below.

$122\,000 \times .90 = 110\,000$ for 5 in vent — not sufficient. From Table C.2, select 6 in vent
 $186\,000 \times .90 = 167\,000$.

This is greater than the required 120 000; therefore, use a 6 in vent and connector when three elbows are used.

(c) Read across to the "NAT DP" column until a vent capacity greater than 120 000 Btuh is located. In this case, a 6 in diameter vent has a capacity of 149 000 Btuh and may be used for this application.



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

A 135 000 Btuh draft hood-equipped furnace is to be vented into a 15 ft high tile-lined masonry chimney. The chimney is not exposed to the outside except above the roof line. The furnace requires a 10 ft lateral vent connector with 2 elbows. The chimney is constructed using an 8 in x 8 in liner. The house contains a clothes dryer and a range hood.

- (a) What is the smallest size single-wall vent connector permitted?
- (b) Is the tile flue adequately sized?
- (c) What size of certified chimney liner would be required if the chimney is in poor condition?

Solution

- (a) Table C.6 should be used. To determine the required vent connector diameter, read down the height column in Table C.6 until 15 ft is found.

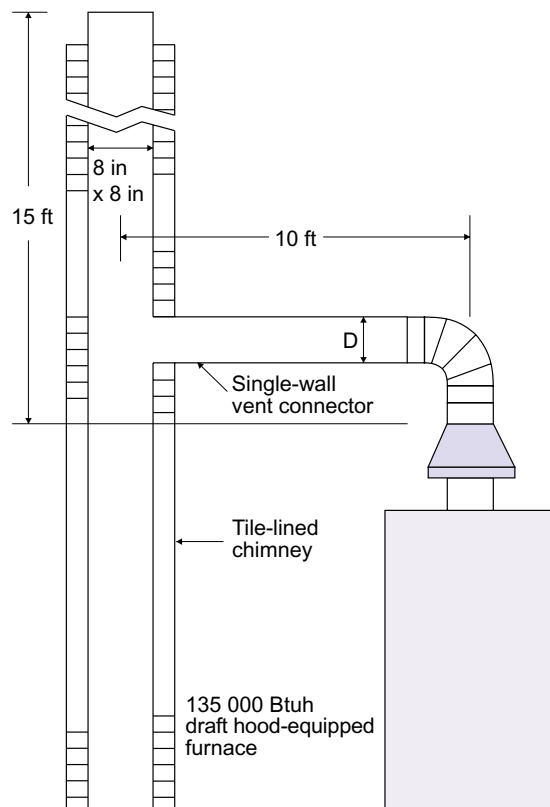
Find the row for a 10 ft long lateral. The table shows under the “NAT DP” column that a 7 in diameter connector has a listed capacity that will allow a maximum capacity of 182 000 Btuh.

(b) The internal area of the chimney (8 in x 8 in) is 42.7 in² (see Table C.10 in Appendix C) and is not within the acceptable range (50 in² to 269 in²) for a 7 in vent connector as shown in Table C.6.

(c) Assume a smooth-walled liner will be used inside the 8 in x 8 in flue. (Always check with the authority having jurisdiction to determine if the lining system is acceptable.)

Using Table C.2, the first “NAT DP” column listing that is equal to or greater than 135 000 Btuh is 173 000 Btuh, corresponding to a 6 in diameter vent connector and liner. Note that the vent connector and vent diameter are always the same throughout Tables C.1 to C.4.

The next example illustrates sizing a corrugated liner in this situation.



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

When a certified corrugated liner is used, General Venting Requirements no. 10 requires that the capacity be reduced by 20%. In other words, only 80% of the listed capacity in the tables is actually carried by the corrugated liner.

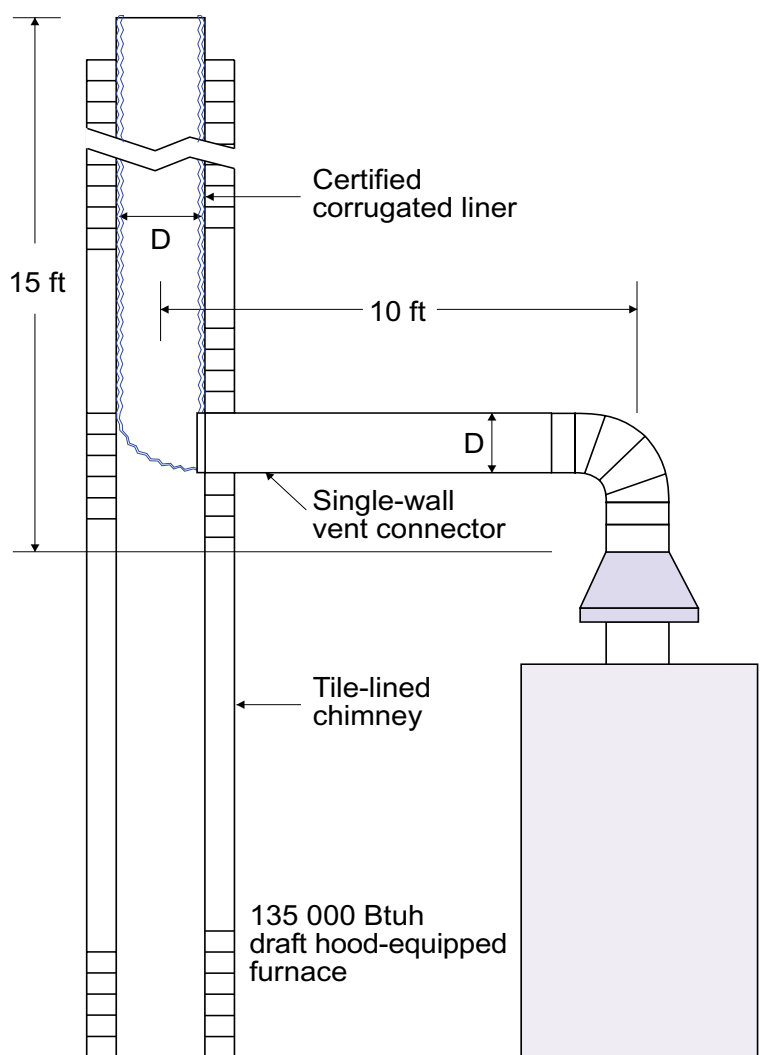
A simple way to find the correct diameter of the liner is to adjust the capacity of the appliance by

noting that $\frac{1.00}{0.80} \times 100\% = 125\%$.

Taking $135\,000 \times 1.25 = 168\,750$ Btuh. This adjusted input may be used to determine the size of the corrugated liner.

Using Table C.2, a height of 15 ft and a lateral of 10 ft, the first "NAT DP" column with a listed capacity equal to or greater than 168 750 Btuh is 173 000 Btuh, corresponding to a 6 in diameter.

A check may be performed by taking $173\,000 \times 0.8 = 138\,400$ Btuh, which is greater than 135 000 Btuh.



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

A 35 000 Btuh fan-assisted furnace is to be common vented with a 150 000 Btuh boiler, using a common vent with a total height of 30 ft. The connector rise is 2 ft for the furnace and 3 ft for the boiler. Assume Type B vent connectors will be used with a Type B common vent.

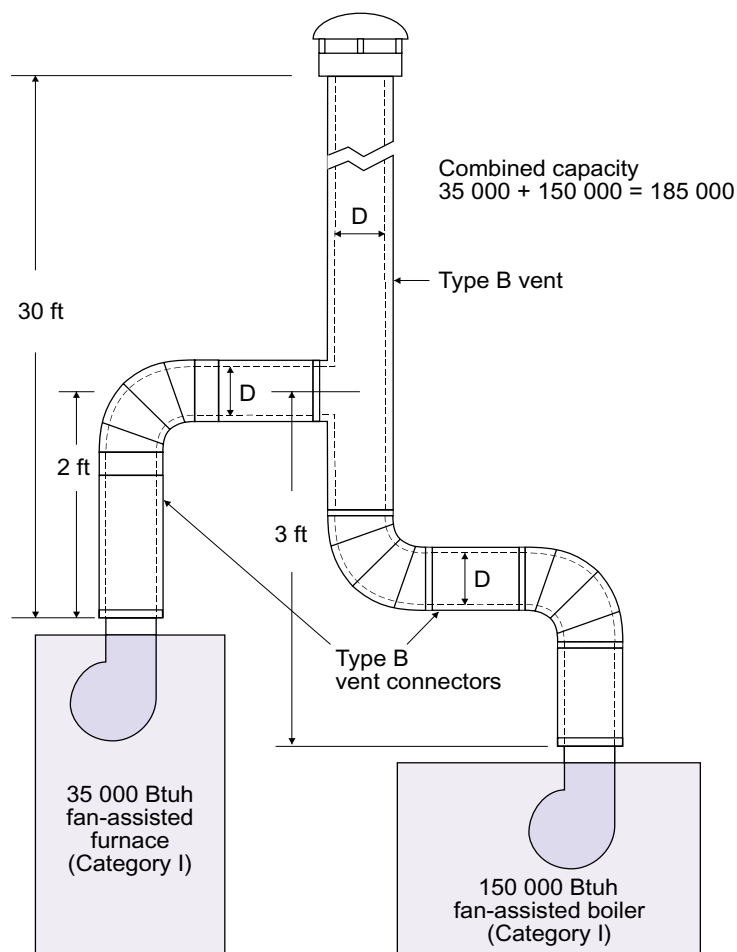
What size connectors and combined vent should be used in this installation?

Solution

Table C.3 should be used to size Type B vent connectors attached to a Type B vertical vent (see

Figure C.3 in Appendix C). In the Vent Connector Capacity section of Table C.3, find the row associated with a 30 ft vent height. For a 2 ft rise on the vent connector for the furnace, read under the column "FAN Min Max" to find that a 3 in diameter vent connector has a capacity ranging between 21 000 and 64 000 Btuh. For the boiler, a 5 in diameter vent connector is required.

For the capacity of the combined vent, the lower portion of Table C.3, Common Vent Capacity, should be used. The combined vent capacity required is 185 000 Btuh. Looking under the "FAN + FAN" columns in Table C.3, a 5 in diameter vent with a 30 ft vent height has a capacity of 244 000 Btuh.



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

A 35 000 Btuh water heater is to be common vented with a 150 000 Btuh furnace, using a common vent with a total height of 30 ft. The connector rise is 2 ft for the water heater and 3 ft for the furnace. Assume single-wall vent connectors will be used with Type B vent. The house has a clothes dryer and a range hood installed.

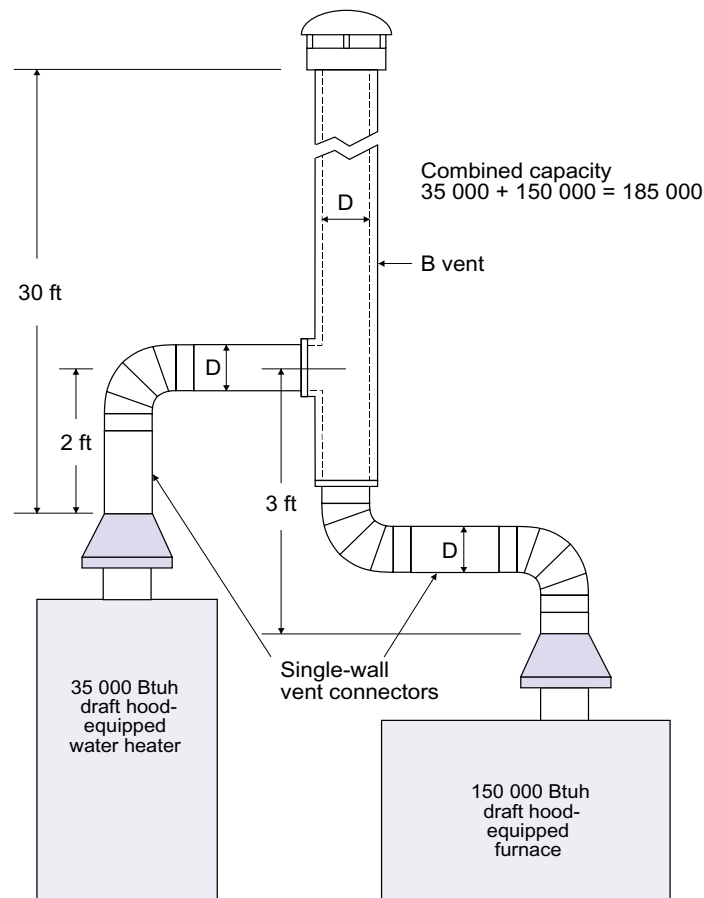
What size connectors and combined vent should be used in this installation?

Solution

Table C.4 should be used to size single-wall vent connectors attached to a Type B vertical vent

(see Figure C.4 in Appendix C). In the Vent Connector Capacity section of Table C.4, find the row associated with a 30 ft vent height. For a 2 ft rise on the vent connector for the water heater, read the column “NAT DP” for Draft Hood-Equipped appliances to find that a 4 in diameter vent connector is required. For the furnace, a 6 in diameter vent connector is required. The “NAT DP” columns are used because the house has air-exhausting equipment installed.

For the capacity of the combined vent, the lower portion of Table C.4, Common Vent Capacity, should be used. The combined vent capacity required is 185 000 Btuh. Table C.4 shows that the combined vent capacity of a 6 in diameter vent with a 30 ft vent height is 239 000 Btuh under the “DP (N+N)” column. This is more than adequate to handle the 35 000 Btuh input water heater and the 150 000 Btuh input furnace.



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

In this case, a 35 000 Btuh input draft hood-equipped water heater with a 2 ft connector rise is to be common vented with a 100 000 Btuh fan-assisted furnace with a 3 ft connector rise. The common vent consists of a 30 ft height of Type B vent. Both vent connectors are Type B.

What are the recommended vent diameters for each connector and the common vent? Assume that the house is new and contains air-exhausting equipment that may depressurize the house up to 5 Pa.

Solution**Water Heater Vent Connector**

Using Table C.3, Vent Connector Capacity, read down the "Vent Height H" column to 30 ft and read across the 2 ft "Vent Connector Rise R" row to the first Btuh rating in the "NAT DP" column that is equal to or greater than the water heater input rating. The table shows that a 3 in vent connector has a maximum input rating of 36 000 Btuh. Since this is greater than the water heater input rating, a 3 in vent connector is adequate.

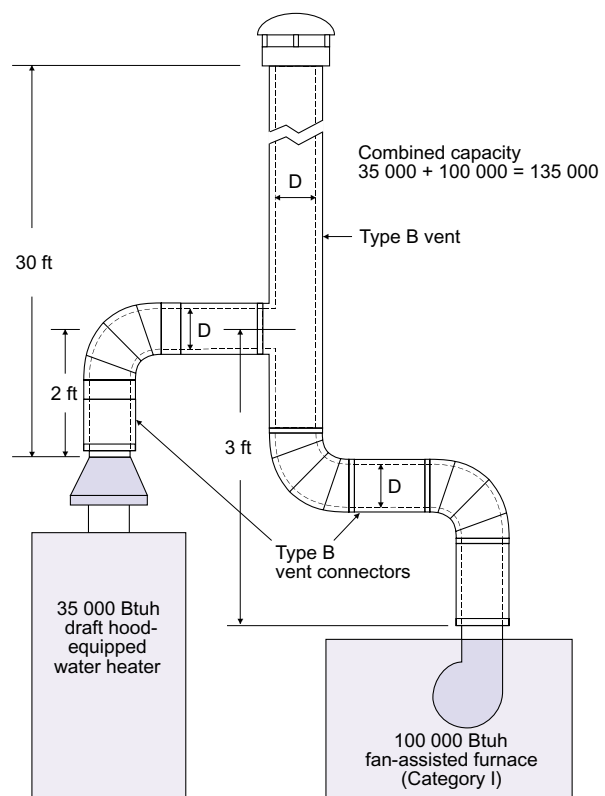
Furnace Vent Connector

Using Table C.3, Vent Connector Capacity, read down the "Vent Height H" column to 30 ft and across the 3 ft "Vent Connector Rise R" row. Since the furnace has a fan-assisted combustion system, find the first "FAN Min Max" column with a Btuh rating greater than the furnace input rating. The 4 in vent connector has a minimum input rating of 34 000 Btuh and a maximum input rating of 123 000 Btuh. The 100 000 Btuh furnace in this example falls within this range, so a 4 in connector is adequate.

Common Vent Diameter

The total input to the common vent is 135 000 Btuh. Using Table C.3, Common Vent Capacity, read down the "Vent Height H" column to 30 ft and across this row to find the smallest vent diameter in the "DP (F+N)" column that has a Btuh rating equal to or greater than 135 000 Btuh. The 4 in common vent has a capacity of 128 000 Btuh and the 5 in common vent has a capacity of 195 000 Btuh.

Therefore, the 5 in common vent should be used in this example.



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

A 40 000 Btuh input, draft hood-equipped water heater, with 2 ft of connector rise, is to be common vented with a 60 000 Btuh fan-assisted furnace with 1 ft of connector rise. The common vent is an 8 in x 12 in tile-lined chimney that is 30 ft high.

What are the recommended vent diameters for each of the Type B connectors? Is the tile-lined chimney adequately sized?

Solution

Table C.7 is used to size common venting installations involving Type B vent connectors into masonry chimneys.

Water Heater Vent Connector

Using Table C.7, Vent Connector Capacity, read down the "Total Vent Height H" column to 30 ft and read across the 2 ft "Vent Connector Rise R" row to the first Btuh rating in the "NAT DP" column that is equal to or greater than the water heater input rating. Table C.7 shows that a 3 in vent connector has a maximum input of only 33 000 Btuh while a 4 in vent connector has a maximum input of 61 000 Btuh. A 4 in vent connector must therefore be used.

Furnace Vent Connector

Using Table C.7, Vent Connector Capacity, read down the "Total Vent Height H" column to 30 ft and across the 1 ft "Vent Connector Rise R" row. Since the furnace has a fan-assisted combustion system, find the first "FAN Min Max" column with a Btuh rating greater than the furnace input rating. The 4 in vent connector has a maximum input rating of 111 000 Btuh and a minimum input rating of 37 000 Btuh. The 60 000 Btuh furnace falls within this range, so a 4 in connector is adequate.

Masonry Chimney

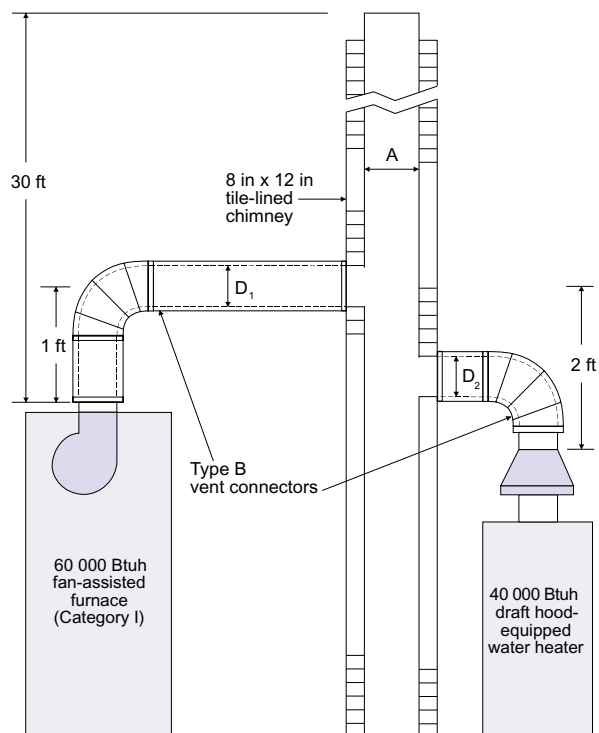
From Table C.10, the internal area of an 8 in x 12 in liner is 63.6 in². Using Table C.7, Common Vent Capacity, read down the "DP (F+N)" column until a capacity equal to or greater

than 100 000 Btuh is found across from the 30 ft height. A chimney with a minimum internal area of 28 in² provides a capacity of 251 000 Btuh, so the chimney is not too small. It may, however, be oversized.

Important Check

Clause 7.12.8 of the Code does not permit the listed capacity of the chimney flue to exceed the combined appliance input rating by more than 25%. For a combined input of 100 000 Btuh, the limit is $100\,000 \times 1.25 = 125\,000$ Btuh. The listed capacity of the chimney at 251 000 Btuh is too high, indicating that excessive condensation would occur. A B vent or liner would have to be installed in this case.

See the next example for sizing a liner in this situation.



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

This example begins where Example 8 ended. It was concluded in Example 8 that the chimney could not be used because it was oversized.

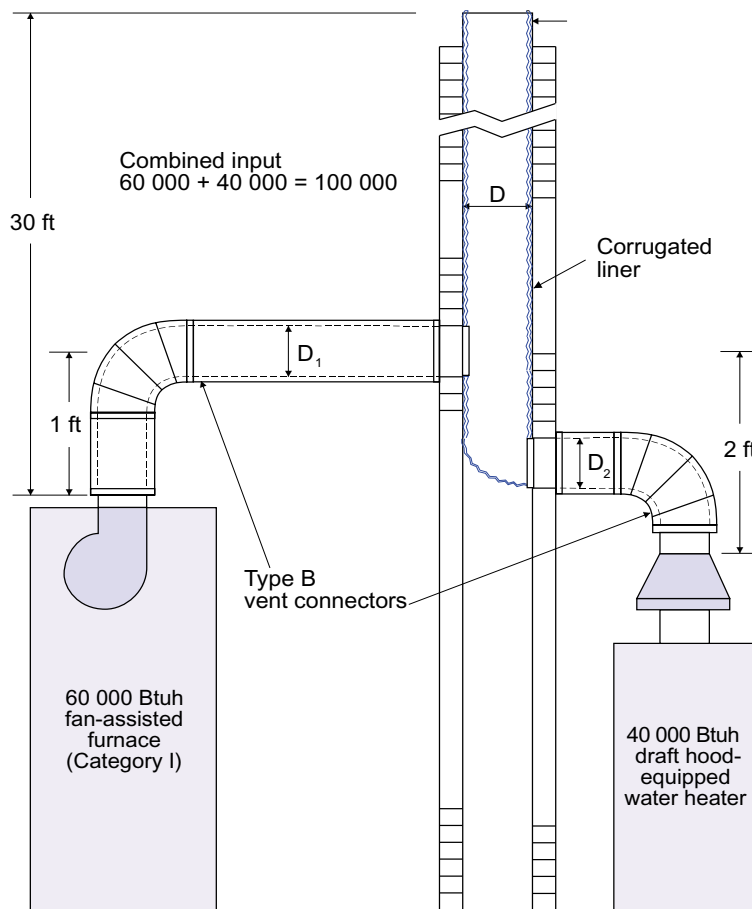
When a certified corrugated liner is used, General Venting Requirements no. 10 requires that the capacity be reduced by 20%. In other words, only 80% of the listed capacity in the tables is actually carried by the corrugated liner.

A simple way to find the correct diameter of the liner is to adjust the capacity of the appliance by noting that $\frac{1.00}{0.80} \times 100\% = 125\%$. In this

case, $100\,000 \times 1.25 = 125\,000$ Btuh. This adjusted input may be used to determine the size of the corrugated liner.

Using Table C.3, Common Vent Capacity, and a height of 30 ft, the first "DP (F+N)" column with a listed capacity equal to or greater than 125 000 Btuh is 128 000 Btuh, corresponding to a 4 in diameter.

A check may be performed by taking $128\,000 \times 0.8 = 102\,400$ Btuh, which is greater than 100 000 Btuh.



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

In this case, a 40 000 Btuh input draft hood-equipped water heater with a 1 ft connector rise is to be common vented with a 60 000 Btuh fan-assisted furnace with a 2 ft connector rise. The common vent consists of a 30 ft height of Type B vent. Both vent connectors are single-wall type attached to a vent connector manifold. A vent connector manifold is defined as any horizontal section of a vent connector upstream of the vertical common vent connected to two or more appliances.

What are the recommended vent diameters for each connector and the common vent? Assume that the house is new and contains air-exhausting equipment that may depressurize the house up to 5 Pa. Account for the vent connector manifold according to General Venting Requirements no. 4.

Solution**Water Heater Vent Connector**

Using Table C.4, Vent Connector Capacity, read down the "Vent Height H" column to 30 ft and read across the 1 ft "Vent Connector Rise R" row to the first Btuh rating in the "NAT DP" column that is equal to or greater than the water heater input rating. The table shows that a 4 in vent connector has a maximum input rating of 53 000 Btuh. Since this is greater than the water heater input rating, a 4 in vent connector is adequate.

Furnace Vent Connector

Using Table C.4, Vent Connector Capacity, read down the "Vent Height H" column to 30 ft and across the 2 ft "Vent Connector Rise R" row. Since the furnace has a fan-assisted combustion system, find the first "FAN Min Max" column with a range containing the furnace input rating. The 3 in vent connector has a minimum input rating of 50 000 Btuh and a maximum input rating of 62 000 Btuh. The 60 000 Btuh furnace in this example falls within this range, so a 3 in connector is adequate.

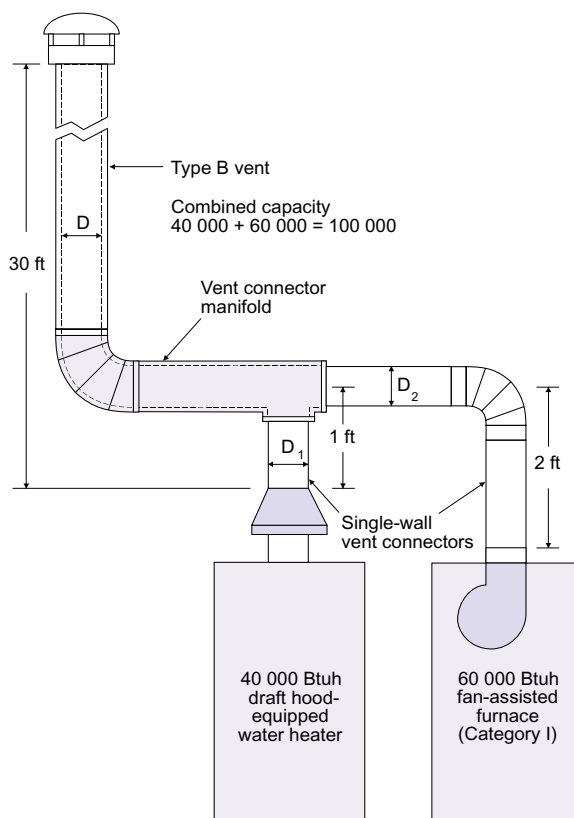
Common Vent Diameter

The total input to the common vent is 100 000 Btuh. General Venting Requirement no. 4 requires that the common vent capacity be reduced by 10%, to 90%, when a vent connector manifold is used.

A simple way to find the correct diameter of the vent is to adjust the capacity of the appliance by noting that $\frac{1.00}{0.90} \times 100\% = 111\%$.

In this case, $100\,000 \times 1.11 = 111\,000$ Btuh. This adjusted input may be used to determine the size of the common vent.

Using Table C.4, Common Vent Capacity, read down the "Vent Height H" column to 30 ft and across this row to find the smallest vent diameter in the "DP (F+N)" column that has a Btuh rating equal to or greater than 111 000 Btuh. The 4 in common vent has a capacity of 123 000 and may be used.



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

In this case, a 40 000 Btuh input draft hood-equipped water heater with a 2 ft connector rise is to be common vented with a 90 000 Btuh fan-assisted furnace with a 3 ft connector rise. The common vent consists of a 30 ft height of Type B vent. Both vent connectors are single-wall type. The Type B common vent requires an offset to bypass existing ductwork and piping.

What are the recommended vent diameters for each connector and the common vent? Assume that the house is new and contains air-exhausting equipment that may depressurize the house up to 5 Pa. Account for the common vertical vent offset according to General Venting Requirements no. 5.

Solution**Water Heater Vent Connector**

Using Table C.4, Vent Connector Capacity, read down the "Vent Height H" column to 30 ft and read across the 2 ft "Vent Connector Rise R" row to the first Btuh rating in the "NAT DP" column that is equal to or greater than the water heater input rating. The table shows that a 4 in vent connector has a maximum input rating of 62 000 Btuh. Since this is greater than the water heater input rating, a 4 in vent connector is adequate.

Furnace Vent Connector

Using Table C.4, Vent Connector Capacity, read down the "Vent Height H" column to 30 ft and across the 3 ft "Vent Connector Rise R" row. Since the furnace has a fan-assisted combustion system, find the first "FAN Min Max" column with a range containing the furnace input rating. The 4 in vent connector has a minimum input rating of 85 000 Btuh and a maximum input rating of 119 000 Btuh. The 90 000 Btuh furnace in this example falls within this range, so a 4 in connector is adequate.

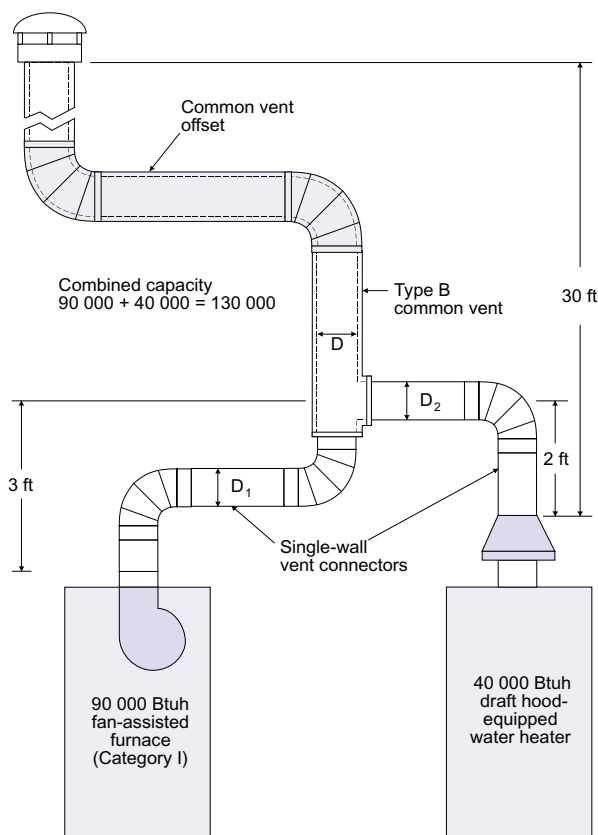
Common Vent Diameter

The total input to the common vent is 130 000 Btuh. General Venting Requirement no. 5 requires that the common vent capacity be reduced by 20%, to 80%, when a common vent offset is used.

A simple way to find the correct diameter of the vent is to adjust the capacity of the appliance by noting that $\frac{1.00}{0.80} \times 100\% = 125\%$.

In this case, $130\,000 \times 1.25 = 162\,500$ Btuh. This adjusted input may be used to determine the size of the common vent.

Using Table C.4, Common Vent Capacity, read down the "Vent Height H" column to 30 ft and across this row to find the smallest vent diameter in the "DP (F+N)" column that has a Btuh rating equal to or greater than 162 500 Btuh. The 5 in common vent has a capacity of 188 000 Btuh and may be used.



Example 12**Interpolating between Table Values**

An installer has an 80 000 Btuh input appliance with a 4 in diameter draft hood outlet that needs to be vented into a 12 ft high Type B vent. The vent connector has a 5 ft lateral length and is also Type B. Can this appliance be vented using a 4 in diameter vent?

Solution

Table C.1 is used in the case of an all Type B vent system. However, since there is no entry in Table C.1 for a height of 12 ft, interpolation must be used. Read down the 4 in diameter "NAT Max" column to the row associated with 10 ft height and 5 ft lateral to find the capacity value of 77 000 Btuh. Then read further down to the 15 ft height and the 5 ft lateral to discover the capacity value of 87 000 Btuh. The difference between the 15 ft height capacity value and the 10 ft height capacity value is 10 000 Btuh. The capacity for a vent system with a 12 ft height is equal to the capacity for a 10 ft height plus $\frac{2}{5}$ of the difference between the 10 ft and 15 ft height values, or $77\,000 + (\frac{2}{5} \times 10\,000) = 81\,000$ Btuh. Therefore, a 4 in diameter vent may be used in the installation.

