Standardized Terminology for Combustion Appliances and Combustion Safety Testing

Air-Free Carbon Monoxide – A measurement of CO in an air sample or flue gas that takes into account the amount of excess air (oxygen, O_2) in the sample, incorporating an adjustment to the as-measured CO ppm value, thus simulating air-free (oxygen-free) conditions in the sample. Usually measured in units of parts per million (ppm). See *As-Measured Carbon Monoxide*.

Ambient – Surrounding conditions. Usually refers to the air around a combustion appliance.

ANSI – American National Standards Institute.

As-Measured Carbon Monoxide – A measurement of CO in a sample of air or flue gas that does not take account of the amount of excess air (oxygen, O_2) diluting the CO concentration. Usually measured in units of parts per million (ppm). See *Air-Free Carbon Monoxide*.

Appliance Depressurization Limits – The ambient depressurization at which the venting of a combustion appliance is likely to become hazardous for those testing the appliance or for the usual occupants of the building. Refer to Table 1 for depressurization limits for most vented combustion appliances.

Atmospheric Burner – A burner utilizing *atmospheric combustion.* (Based on NFPA 54)

Atmospheric Combustion – Combustion which takes place under *atmospheric pressure* at a given altitude, without the use of a fan to regulate combustion supply air. (Based on NFPA 54)

Atmospheric Pressure – The weight of air and its contained water vapor on the surface of the earth. At sea level this pressure is 14.7 pounds per square inch. (Based on NFPA 54)

Balanced Flue Vent System – Term used for oil-fired systems to indicate a direct-vent appliance with positive pressure in the vent connector through which the gases of combustion pass.

Barometric Damper – See *Draft Regulator*.

Barometric Draft Regulator - See *Draft Regulator*.

Boiler – A space heating appliance that heats water with hot combustion gases.

Breeching or Breech – See *Vent Connector*.

Carbon Monoxide Emissions – Carbon monoxide (CO) is an odorless and colorless gas that can cause sickness and death. To measure the CO emissions in flue gas, the CO sample must be taken before dilution air enters the vent system. CO emissions are measured in parts per million (ppm). See *Air-Free Carbon Monoxide* and *As-Measured Carbon Monoxide*.

Category I Gas Appliance – An appliance that operates with negative static pressure in the vent and a temperature that is high enough to avoid condensation in vent. *Comment: May be atmospheric burner or fan-assisted combustion; airtight vent connector is not required.* See **Figure 1**. (Based on NFPA 54)

Category I Fan-Assisted Gas Appliance – An appliance that operates with negative static pressure in the vent, a temperature that is high enough to avoid condensation in vent, and an integral fan to draw a controlled amount of combustion supply air through the combustion chamber. *Comment: Airtight vent connector is not required; induced combustion fan installed by manufacturer.* See **Figure 2** (Based on NFPA 54)

Category II Gas Appliance – An appliance that operates with negative static pressure in the vent and a temperature that is low enough to cause excessive condensation in the vent. *Comment: No or very little equipment in this category.* (Based on NFPA 54)

Category III Gas Appliance – An appliance that operates with positive static pressure in the vent and a temperature that is high enough to avoid condensation in vent*. Comment: Airtight vent connector; vented through the wall; forced draft.* (Based on NFPA 54)

Category IV Gas Appliance - An appliance that operates with positive static pressure in the vent and a temperature that is low enough to cause excessive condensation in the vent. *Comment: Airtight vent connector; vented through the wall; forced draft; often referred to as a "90-plus"or "condensing" unit.* See **Figure 3.** (Based on NFPA 54)

CAZ – See *Combustion Appliance Zone*.

Central Return – System of ducts or passages for distribution return air, which connect different areas of the house to a central location at the forced air furnace.

Chimney Flue – A passageway in a chimney for exhausting combustion gases to the outdoors. (Based on NFPA 54)

Cleanout Opening – An opening in a chimney (usually at its base) to allow inspection and the removal of ash or debris. (Based on NFPA 211).

Combustion Appliance Zone (CAZ) – Room and enclosed air volume that contains a combustion appliance. This may include, but is not limited to, a mechanical room, mechanical closet, or main body of the house.

Common Vent – The portion of the vent or chimney through which products of combustion from more than one appliance pass. (Based on NFPA 54)

Concentrically Constructed Direct-Vent – A *direct-vent appliance* that has an exhaust-gas vent and a combustion-supply air vent arranged in a concentric fashion, i.e., one vent is inside the other with a

space between the walls of each. *Comment: Mobile home furnace vents are usually constructed this way; some Category I, direct-vent water heaters are constructed this way.*

Dilution Air – Air that enters a draft hood or draft regulator of a *Category I*, *natural draft* appliance from the room in which the appliance is located. (Based on NFPA 54)

Direct-Vent Appliance – A combustion appliance for which all combustion gases are vented to the outdoors through an exhaust vent pipe and all combustion supply air is vented to the combustion chamber from the outdoors through a separate, dedicated supply-air vent. *Comment: Most direct-vent gas appliances are Categories III and IV, but some are Category I; some direct-vent appliances utilize "Concentrically Constructed Direct-Vent".* (Based on NFPA 54)

Downdraft – Air flowing down a chimney or vent during the appliance off-cycle.

Draft – A pressure difference that causes combustion gases or air to move through a vent connector, flue, chimney, or combustion chamber. May be *natural draft*, *induced draft*, or *forced draft*. Draft is often measured with a draft gauge (manometer or pressure gauge). (Based on NFPA 54)

Draft Diverter – See *Draft Hood*.

Draft Fan – A mechanical fan used in a venting system to augment the *natural draft* in gas- and oil-fired appliances. These electrically operated, paddle-fan devices are installed in vent connectors. (Based on NFPA 211)

Draft Hood – A nonadjustable device built into an appliance or a part of the vent connector that is intended to 1) provide for escape of flue gases if blockage or backdraft occurs, 2) prevent a downdraft of outdoor air from entering the appliance, 3) neutralize the effect of stack action of the chimney, and 4) lower the dew point temperature of the flue gas by the infusion of ambient room air. (Based on NFPA 54)

Draft Regulator – An adjustable and self-regulating damper attached to a chimney or vent connector for the purpose of controlling draft. A draft regulator can reduce draft; it cannot increase draft.

Fan-Assisted Combustion – A combustion appliance with an integral fan to draw combustion supply air through the combustion chamber. *Comment: Category I fan-assisted gas furnaces utilize this method of combustion air regulation.* (Based on NFPA 54)

Forced Draft – A vent system for which a fan installed at the combustion appliance moves combustion gases to the outdoors with positive static pressure in the vent pipe. Because of this positive pressure, the vent connector must be air-tight. *Comment: Normally Category III or IV appliances; usually no draft diverter or barometric damper; fan for venting combustion gases at or near appliance; usually vented through the wall; may be condensing.* (Based on NFPA 54)

Furnace – A space heating appliance that heats air with hot combustion gases.

Gas Oven Bake Burner – Oven burner used for baking located just below the oven compartment floor.

Gas Oven Broiler Burner – Oven burner used for broiling located at the top of the oven compartment.

Inches of Water Column (IWC) – A non-metric unit of pressure difference. One IWC is equal to about 250 Pascals.

Induced Combustion – See *Fan-Assisted Combustion*.

Induced-Combustion Fan – A mechanical device intended to pull a consistent volume of combustion supply air through the combustion area on a Category I, fan-assisted, gas-fired appliance. *See Fan-Assisted Combustion. See Figure2.*

In-Line Draft-Inducer Fan – A mechanical device installed between Category I appliance and connection to chimney in single-wall vent connector, intended to assist negative draft. Fan control is interlocked with burner(s).

Induced Draft – A vent system for which a fan – installed at or very near the termination point of the vent pipe/system – moves the combustion gases to the outdoors with negative static pressure in the vent. *Comment: Normally Category I appliances; fan for venting combustion gases at point of exit to outdoors); vented through the wall or at the top of a chimney; termination induced-draft fans. See Figure 4.* (Based on NFPA 54)

Isolated Outdoor Air Supply - Term used with oil-fired systems to indicate a vent pipe through which outdoor combustion supply is ducted to the oil burner. *Comment: Often added on-site, these non-airtight outdoor air supply vents are sometimes installed with a vacuum relief damper that allows all the combustion supply air to be taken from the CAZ if the outdoor air inlet becomes blocked.*

Mechanical Draft – A combustion appliance with induced draft of forced draft. (Based on NFPA 54)

Natural Draft – A vent system that relies on natural draft (hot, buoyant air) to move combustion gases to the outdoors. *Comment: Category I appliances; atmospheric, fan-assisted, or power burner type combustion; sometimes direct-vent; might be through-the-wall vented.* (Based on NFPA 54)

Open-Combustion Appliance – A combustion appliance that takes its combustion air from the surrounding room. Contrast this with a direct-vent appliance.

Pascal (Pa) – The metric unit of pressure difference and is the equivalent to one Newton per square meter or one Joule per cubic meter. One Pascal is equal to 0.004 IWC.

Power Burner – A burner for which air is supplied at a pressure greater than atmospheric pressure. Most oil-fired burners are power burners. Gas burners used to replace oil burners are usually power burners.

Power Draft – See *Mechanical Draft*.

Spillage – Combustion gases emerging from an appliance or venting system into the CAZ during burner operation.

Through-the-Wall Vented – Combustion appliances that are vented through a wall rather than into a vertical-rise chimney or vent. Such appliances are usually Category III or IV, but might also be Category I (for example, a direct-vent Category I water heater).

Vent Category – One of four categories for gas-fired appliances defined in the *National Fuel Gas Code*, NFPA 54. See Table 2 and *Category I Gas Appliance*, *Category I Fan-Assisted Gas Appliance*, *Category II Gas Appliance, Category III Gas Appliance*, and *Category IV Gas Appliance.*

Vent Connector – A pipe that connects the combustion appliance to a vent, chimney, or runs directly to the outdoors. (Based on NFPA 54).

Venting System – A continuous passageway from a combustion appliance to the outdoors through which combustion gases can safety pass.

Table 1: Combustion Appliance Depressurization Limits	
Combustion Appliance Type	**Maximum Depressurization Limit, Pascals**
Appliances with manufacturer certified negative pressure tolerance rating	The manufacturer- certified negative pressure tolerance rating
Atmospheric-burner water heater only (Category I, natural draft), open-combustion appliance, orphaned and not installed in a code-compliant chimney size	-2
Atmospheric-burner water heater (Category I, natural draft) and common-vented atmospheric-burner furnace (Category I, natural draft), open-combustion appliances	-3
Atmospheric-burner water heater (Category I, natural draft) and common-vented Category I fan-assisted furnace, open-combustion appliances	-5
Atmospheric-burner water heater (Category I, natural draft) installed as a stand-alone unit vented into a code-compliant chimney.	-5
Gas furnace or boiler, Category I or Category I fan-assisted, open-combustion appliances	-5
Oil or gas unit with power burner, low- or high-static pressure burner, open-combustion appliances	-5
Closed, controlled wood-burning appliances	-7
Induced-draft appliances (fan at point of exit at wall), Category I with induced draft, open-combustion appliances	-15
Pellet stoves with exhaust fans and sealed vents	-15
Gas appliances, Category III or Category IV, vented through the wall, forced draft, open-combustion appliances	-15
Direct-vent, sealed combustion appliances with forced draft	-25
Adapted from Minnesota Energy Code 7672.0900 and Canadian General Standards Board 51.71. August 2017	

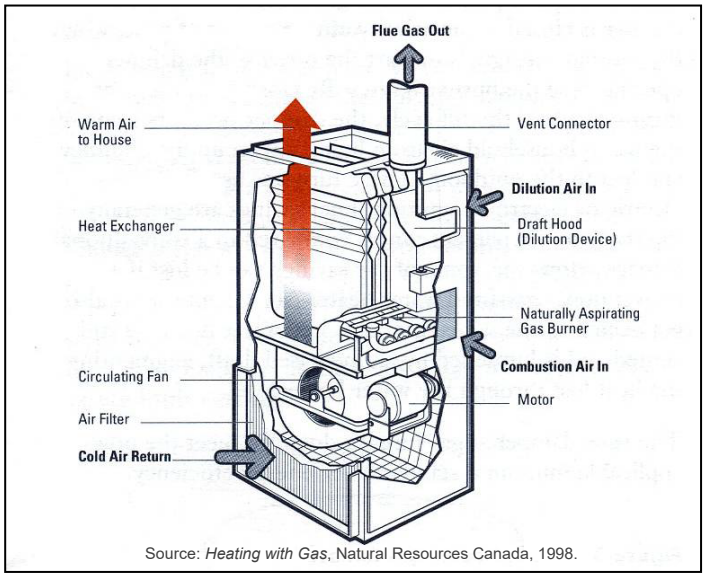


Figure 1. Category I, natural draft furnace

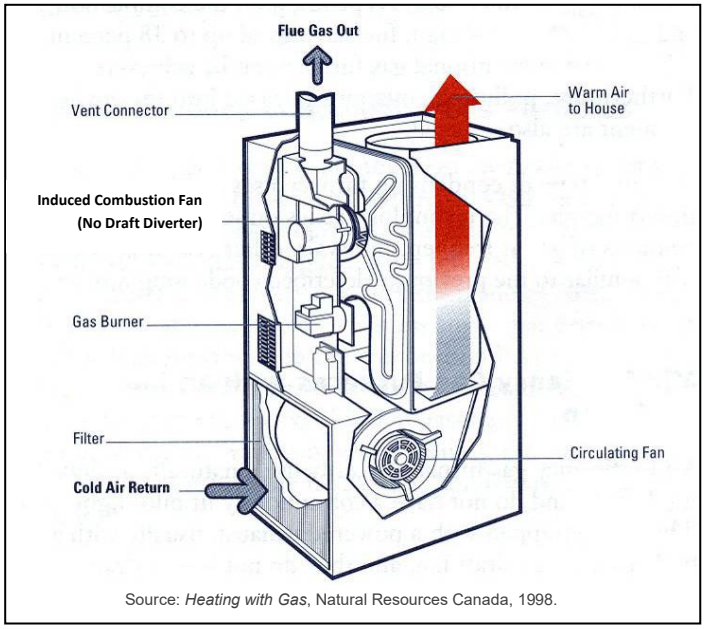


Figure 2. Category I, fan assisted furnace, induced combustion, natural draft

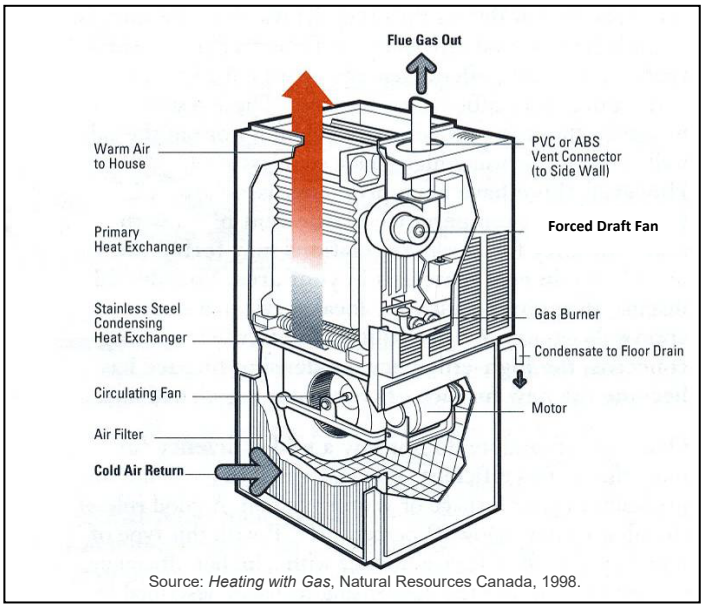


Figure 3. Category IV, forced draft, condensing furnace

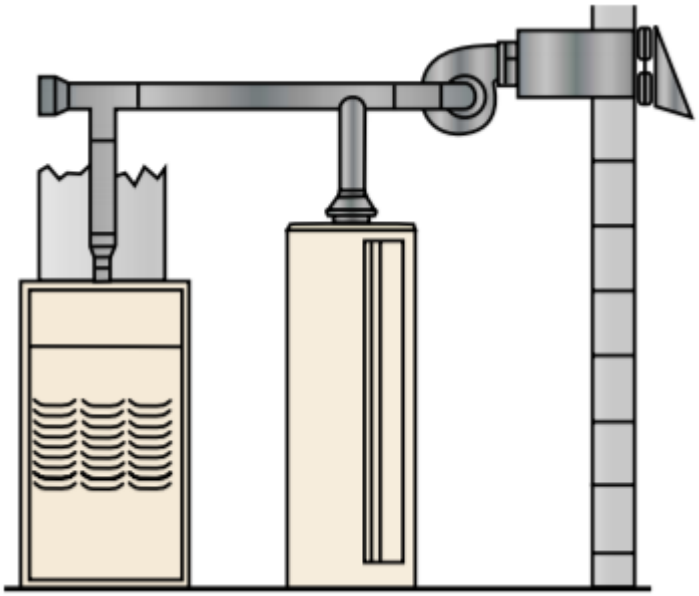


Figure 4. Induct-draft fan venting through wall, with common-vented appliances

Source: Tjernlund Products, Inc.

Appliance Category	Vent Pressure	Condensing or Non-Condensing?	Typical Flue Pipe Material
I	Non-Positive	Non	B-Vent
II	Non-Positive	Condensing	Special per Manufacturer
III	Positive	Non	Stainless Steel
IV	Positive	Condensing	Plastic

Table 2. Overview of Gas-Fired Vent Categories

Document revised August 2017
R. Karg, Residential Energy Dynamics, LLC, 596 Grover Hill Road, Bethel, Maine 04217
rjkarg@redcalc.com (*comments are welcome*)