

commercial and industrial customers and require standby fuel equipment. Burners are available that are readily changed over from city gas to liquefied petroleum (bottled) gas, or to oil. This changeover may be accomplished manually or semi-automatically through an electric switch.

Oil burners of the high-pressure, low-pressure, or rotary-cup type are used, using No. 2 or heavier oils.

Chapter 51 gives details of the burners and control systems used on commercial and industrial furnaces.

Induced draft fans that operate in conjunction with the burner are often part of the packaged commercial-industrial furnaces.

ASHRAE Standard 45-64, *Methods of Testing for Rating Non-Residential Warm Air Heaters*, gives rating limits and test procedures. U.L. 727 gives requirements for Underwriters' Listing. Gas-fired furnaces may be approved by American Gas Association. Other insuring agencies such as Factory Mutual, and governmental agencies and codes also frequently have special requirements for commercial-industrial furnaces installed under their jurisdiction.

PART III: SPACE HEATERS

Space heater is a general term applied to room heaters, wall furnaces and floor furnaces.

The American Gas Association Directory gives definitions of these various categories that are generally descriptive regardless of fuel.

Room Heater

A room heater is a self-contained, free-standing, non-recessed, gas-burning, air heating appliance intended for installation in the space being heated and not intended for duct connection. A room heater may be of either the gravity or mechanical air circulation type, vented or unvented.

Wall Furnace

A wall furnace is a self-contained vented appliance complete with grilles or their equivalent, designed for incorporation in, or permanent attachment to, a wall, floor, ceiling or partition, and furnishing heated air circulated by gravity or by fan directly into the space to be heated through openings in the casing. Such appliances should not be provided with duct extensions beyond the vertical and horizontal limits of the casing proper, except that boots not to exceed 10 in. beyond the horizontal limits of the casing for extension through walls of nominal thickness may be permitted. Where such boots are provided, they should be supplied by the manufacturer as an integral part of the appliance and tested as such in accordance with these requirements.

1. *Gravity-Type Vented Wall Furnace*. A recessed wall furnace depending on circulation of air by gravity.
2. *Fan-Type Vented Wall Furnace*. A recessed wall furnace equipped with a fan.

Floor Furnace

A floor furnace is a completely self-contained unit furnace suspended from the floor of the space being heated, taking air for combustion from outside this space, and having means for observing flames and lighting the appliance from such space.

1. *Gravity-Type Floor Furnace*. A floor furnace depending primarily on circulation of air by gravity. This classification also includes floor furnaces equipped with booster type fans which do not materially restrict free circulation of air by gravity flow when such fans are not in operation.
2. *Fan-Type Floor Furnace*. A floor furnace equipped with a fan which provides the primary means for circulation of air.

Solid-Fuel-Fired Heaters

Surface fired heaters are those fired through a front firing door on the top of the fuel bed. Except in the case of heaters designed only for wood, grates are movable and ash is removed through a lower door beneath the grates. Such heaters require firing at frequent intervals depending upon the burning rate.

Magazine heaters have a deep reservoir of fuel to lengthen intervals between firing periods.

Steel is generally used in the construction of solid fuel heaters at the present time for both the heat exchanger and outer cabinet or circulators. Cast iron is used for grates and refractory or cast iron is used for fire box liners. It is important that the heat exchanger be tightly constructed with machined joints on the ashpit and firing doors to maintain a low burning rate.

There is no accepted standard covering the testing and rating of solid fuel space heaters.

Oil Heaters

Vaporizing pot-type oil heaters use burners as shown in Fig. 5 of Chapter 51. The heat exchanger is cylindrical and is made of steel; the flue connection made to this chamber or to a secondary heat exchanger is used to lower flue gas temperatures and thus increase efficiency. The burner may be designed for use with mechanical draft. These heaters may be made as room heaters, (both of the radiant and circulation type) floor furnaces, and recessed wall heaters, depending upon the cabinet construction.

Blue flame oil burners are also vaporizing burners, but of a different type. Removable perforated metal sleeves are provided above an oil pan with lighting rings for easy ignition. Wicks are often used with this type burner for increased vaporization. These burners use only kerosene for fuel. They may be built into radiant or circulating heaters with cylindrical or oval heat exchangers. They may be portable with a wire carrying ball or stationary, and are usually not intended for connection to a flue, thus limiting their use to well ventilated space.

Controls

Vaporizing burners of the pot-type are equipped with a constant level valve and a metering valve built as a single control. Flow is by gravity to the burner through the adjustable metering valve. Control may be manual with an off, pilot and variable settings up to high, or it may be thermostatic with the burner operating at either pilot or high.

Sleeve-type blue flame burners may either use a constant level valve or a gravity feed tank with a metering valve.

Gas Space Heaters

Gas space heaters are made in all three categories, i.e., room heater, wall furnace, and floor furnace.

Room heaters are made both in vented and unvented models, and the other two types are always vented.

Unvented heaters should not have an input in excess of 50,000 Btu per hr. This classification usually also includes unvented open-flame radiant type wall heaters and closed front unvented wall heaters that are limited to 25,000 Btu per hr input. Because unvented heaters discharge their products of combustion into the space being heated as well as getting combustion air from the same space, it is essential that they be used in well ventilated space. The following restrictions are listed in the A.G.A. Directory:

"Room heaters, installed in sleeping quarters for use of transients, as in hotels, motels and auto courts shall be of the vented type and shall be connected to an effective flue or vent and

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equipped with an automatic pilot. It is recommended that room heaters installed in all sleeping quarters or rooms generally kept closed be of the vented type and be connected to an effective flue or vent and equipped with an automatic pilot."

"Room heaters installed at any location in institutions such as Homes for the Aged, Sanatoriums, Convalescent Homes, Orphanages, etc., shall be of the vented type and shall be connected to an effective flue or vent and equipped with an automatic pilot."

Vented room heaters are defined as being capable of removing all of the flue gases through a single flue outlet. These heaters may be designed for gravity circulation of air or may incorporate a fan (either factory applied or added as an accessory) for increased air circulation. A vented gas room heater consists of the burner and controls, heat exchanger, draft diverter and outer cabinet. Each component must be connected to a flue or vent.

Vented room heaters are also made with an integral venting system. Such heaters take all of their air for combustion from outside as well as venting the products of combustion to the outside. The heat exchanger is constructed so that openings into the burner or combustion zone are sealed from the space being heated. The heater must be located against an outside wall and an opening cut through the wall to receive the combination combustion air entrance and flue outlet fitting. The flue outlet fitting is usually concentric so that the vent is through the center and the air inlet is annular. It is constructed to adjust to various wall thicknesses and is designed to function properly under varying wind conditions.

Wall furnaces are made to recess into the stud space of a partition wall. The smaller sizes usually heat a room on one side of the partition but the larger models have a face on both sides of the wall thus heating two rooms. The back draft diverter is built-in and the flue connection is out the top so that the flue may run within the stud space. Underwriters' Laboratories listed type B-W vent must be used.

Wall furnaces are made in both gravity and forced air models. The forced air models are counterflow with the warmed air delivered near the bottom of the unit. They are also made with integral venting systems as described for room heaters. Such models cannot be installed in a partition wall, but must be located on an outside wall.

Fuel

The information on various gases given for gas furnaces also applies to gas space heaters.

Controls

Space heaters of all three categories are usually available with control options.

The basic control is with a manual valve to turn the gas supply on and off. A thermostatically controlled automatic valve to turn the heater on and off in response to temperature changes may also be used. This valve may be of a type operated by a bulb and capillary tubing filled with a gas to sense temperature changes in the room air, or it may be an electrically operated valve using current generated by a pilot flame or by a low-voltage transformer controlled by a wall-mounted thermostat.

Except for unvented heaters, pressure regulators are required on all gases except liquefied petroleum, where the tank regulator is used.

On room heaters, safety pilots are not required except where automatic controls are used, but on wall furnaces and floor furnaces they are required with all control systems.

Efficiencies

Oil heaters meeting Commercial Standard 101 are required to have a minimum efficiency of 70 percent.

Gas heaters passing the American Standard Requirements have the following published efficiencies:

Unvented heaters	70 percent
Vented heaters	70 percent
Wall furnaces and floor furnaces	
Gravity air circulation	70 percent
Forced air circulation	75 percent

Construction and Performance Requirements

1. Gas Burning Equipment (American Standard Approval Requirements)
 - Gas-Fired Room Heaters Z21.11
 - Central Heating Gas Appliances Z21.13
 - Volume II (Z21.13.2) Gravity and Forced Air Central Furnaces
 - Volume III (Z21.13.3) Gravity and Fan Type Floor Furnaces
 - Volume IV (Z21.13.4) Gravity and Fan Type Vented Wall Furnaces
2. Oil Burning Equipment
 - Underwriters' Laboratories Standards for Safety
 - Floor Furnaces UL 729
 - Recessed Heaters UL 730
 - Portable Kerosene Heaters UL 647 (a)
 - Kerosene Stoves for Cooking and Heating UL 647 (b)
 - Oil Burning Stoves UL 896
 - Oil Burners UL 296
 - Oil Fired Central Furnaces UL 727
 - Commercial Standards Publications
 - Oil Fired Room Heaters CS 101
 - Oil Fired Central Furnaces CS 195
 - Oil Burners CS 75
3. Electric Space Heating Equipment UL 573

Installation Standards

National Board of Fire Underwriters	NBFU 31
American Standards Association Gas Appliances and Gas Piping	Z21.30

Sealed Combustion Systems

Gas burning appliances employing sealed combustion systems have burners, pilots, combustion chambers, and all flue gas passages completely isolated or sealed from the space in which they are installed. Such appliances are not equipped with draft hoods or vent attachments, since the entire venting system is designed into the unit and tested and approved as an integral part of the appliance. Typically, the flue outlet is extended through an opening in the wall to the outside, and the combustion air inlet, which is usually concentric to the flue, extends through the same wall opening.

Sealed combustion systems operate on the balanced vent principle. The vent termination or point of flue gas discharge and the combustion air inlet, being in the same area, are in the same pressure zone. Thus, any air pressure exerted, such as wind, is applied equally to the inlet and outlet of the combustion area, and venting is accomplished by the chimney action of the hot gases inside the combustion area of the unit, with positively and negatively applied pressures equalizing each other.

Appliances with sealed combustion chambers have certain advantages: (1) they can be installed without the necessity of a conventional venting system, (2) there are fewer restrictions as to the location of the vent termination, (3) there is no