

for oil, and (c) vented and unvented heaters for gas. (The type of gas burner design, such as, injection, yellow flame, power, and pressure, may also be mentioned.)

SOLID FUEL-FIRED HEATERS

Surface fired heaters normally have a front firing door and are operated with relatively shallow fuel beds. A magazine feed heater includes a deep reservoir of fuel to lengthen the attention intervals. In a true magazine feed heater the rate of fuel ignition would be equal to the rate of burning; and self-feeding should operate to move the unburned fuel by gravity flow from the magazine section into the hearth area. However, the ideal balance between rate of ignition and rate of burning is virtually impossible to attain for any solid fuel under normal usage, although self-feeding may be obtained with wood and some free burning coals. Thus, a magazine-type space heater is essentially a deep surface-fired heater, its principal difference being increased fuel capacity.

Materials and Construction

There is no accepted code governing the construction of solid fuel burning space heaters. In past years cast iron was used predominantly in the construction of coal and wood heaters, with the exception of the so called *air tight* heaters designed as low cost wood burning units with little consideration for long life, and stoves were priced on a poundage basis. The present trend is toward fabricated steel parts and welded assemblies, although cast iron is still used for grates, firebox liners, and parts subject to high temperatures. Refractory firebox liners are also used quite extensively.

Formed sheet steel is used predominantly for the outer jacket of circulator heaters, although heaters with outer casings formed from cast iron are still readily available. Circulator cabinets normally have surfaces finished with a porcelain enamel, while the casing of a radiant heater is finished with an air dried japan or a baked enamel.

Both welding and stove bolts are used in unit assembly, and stove cement is used on section joints to prevent air leakage. This latter is extremely important to obtain a low rate of combustion when desired.

Testing and Rating

There is no accepted code governing the method of testing and rating solid fuel space heaters. A tentative procedure, TS-3443, has been issued by the *Division of Trade Standards, National Bureau of Standards* but is based on use of anthracite as a rating fuel although bituminous coals are used predominantly as heating fuels. This procedure which has been the basis of published ratings consists of determining the heater output, expressed in Btu per hour, by the indirect method in which the measurable heat losses: (1) loss due to moisture in the fuel, (2) loss due to heat in the dry flue gases, (3) loss due to unburned carbon monoxide, (4) loss due to unburned combustible in the ash and refuse, and (5) unaccounted for losses, are measured by test and subtracted from the heat input. The difference multiplied by the burning rate in pounds per hour is the heater output.

When using anthracite as the rating fuel, the unaccounted for loss has been assumed to be zero. It has been accepted practice to use a 20 per cent allowance for the unaccounted for losses when burning a bituminous coal. The value of this factor is under study at the present time but no published data are available.

No allowance is made for a radiation loss, as this is useful heat.

Design Considerations

Some important considerations in the design of solid fuel space heaters are:

1. Suitable protection by baffling or insulation against overheating of floors and walls.
2. Tight heater construction to prevent air leakage and to enable maintenance of a suitably low minimum burning rate. This includes a ground, paper tight joint between the ashpit door and door frame.
3. Sufficient free air space between the casing and heat exchanger of circulating heaters to permit free air flow over all surfaces and maintain a suitably low casing temperature.
4. Protection of all metal parts from deterioration due to high temperature. This may be accomplished by: (a) fabrication of certain parts from cast iron or an alloy iron, (b) protection by a refractory liner, (c) use of high temperature enamel coatings, (d) directing air against hot spots.
5. Proper admission of secondary air to complete the combustion process. Care should be taken to prevent this air from also functioning as primary air.
6. Strength in assembly to prevent transportation and use damage.

Considerable work has been directed in the past few years toward improvement of the performance of bituminous coal fired space heaters, with particular reference to smokeless operation under conditions of normal operation such as obtained in homes.

OIL HEATERS

Vaporizing pot type oil heaters consist of: (1) a metal pot in the bottom of which the oil is vaporized, the vapors burning at or near the top of the pot, (2) a secondary combustion chamber, or heat exchanger, in which combustion is completed. The flue connection is made to this chamber or through a second heat exchanger which may be of the diving flue type installed to increase efficiency. The burner may be designed for operation both with and without mechanical draft.

Blue flame oil burners differ from the pot type variety in that removable perforated sleeves are provided above an oil pan instead of a metal pot, and lighting rings or kindlers are used for easy lighting.

Both types of oil burners operate by the burning of the oil vapor rather than the oil itself, the oil being first fed to a chamber in which the oil is entirely vaporized, then mixed with air introduced through suitably located ports and burning at the top of the pot or perforated sleeves. Such heaters are designed to burn No. 1 oil (See Table 4, Chapter 16) or kerosene (coal oil). At no time should oil heavier than that for which the burner is designed be used, as heavier oils may cause excessive carbonization in the burner or fuel feed line.

Materials and Construction

Formed sheet steel and welded assemblies are used primarily in oil heater construction. Standards governing construction which have been generally accepted are:

1. Commercial Standard for Flue-Connected Oil Burning Space Heaters equipped with Vaporizing Pot Type Burners, CS101-43, (*National Bureau of Standards*).
2. Standard for Oil-Burning Stoves, Subject 896, (*Underwriters' Laboratories, Inc.*).
3. Standard for Construction and Performance of Oil Burners for Installation in Stoves and Ranges, Subject 865, (*Underwriters' Laboratories, Inc.*).

Some States or municipalities have codes which apply locally, but these