

Measurement of the Efficiency of Combustion

Efficient combustion being based upon a clean flame and certain proportions of oil and air employed, it is possible to determine the results by analyzing the gases formed by the combustion process. An Orsat apparatus is a device which measures the volume of carbon dioxide (CO_2), oxygen (O_2) and carbon monoxide (CO) in the flue gases. Except in the case of a non-luminous flame it is usually sufficient to analyze only for carbon dioxide (CO_2). A showing of 10 to 12 per cent indicates the best adjustment if the flame is clean. Most of the good installations at the present time show from 8 to 10 per cent CO_2 . Taking into account the potential hazard of oil or air fluctuations with low excess air (high CO_2) a setting to give 10 per cent CO_2 constitutes a reasonable standard for the majority of oil burners.

Additional Design Considerations

Efficient combustion is found to be a question of good design plus a competent installation but it is not the sole feature of a completely satisfactory job. The following items should all be considered: (a) clean and efficient combustion, (b) a setting of the oil-burning rate to give the proper gross load, (c) a boiler to absorb the heat efficiently, (d) quiet operation, and (e) suitable control and safety devices.

The Gross Load

See Chapter 25 for general material on allowances, etc. To the design or heat loss of the house (Chapter 7), it is customary to add an allowance for piping and pick-up. The most common value for piping is 25 per cent and for pick-up 20 per cent. To these allowances should be added an allowance where domestic hot water is heated by the boiler. (See Chapter 35 for information on Domestic Hot Water). The design load plus the allowances indicates the gross load that should be produced by the boiler. While in every case the gross load will exceed the design load if adequate heating response is to be achieved, there is, however, no object whatever in over-estimating the allowances. The only effect would be to reduce the time of pick-up by a few minutes. Otherwise, it might mean forcing the boiler unduly and increasing the cost of operation.

Setting the Rate of Oil Burning

The rate of oil burning to get the gross output depends upon the combustion (*i.e.*, per cent CO_2) and the efficiency of the boiler in absorbing heat. The oil burning rate in conversion jobs—where a burner is placed in existing equipment—is troublesome to adjust accurately because the boiler efficiency is usually a matter of conjecture rather than actual knowledge. In general, each gallon of oil burned per hour will produce a boiler output of from 300 to 450 ft of steam radiation (see Fig. 7). The number of possible burners, adjustments, and boilers makes each installation a separate problem. Obviously, a satisfactory setting depends upon the knowledge, experience and judgment of the individual installer. It seems wise to set the oil-burning rate on the low rather than high side. The tendency has always been the other way. The oil-burning rate can easily be increased. If properly explained to the owner, he will appreciate the situation if subsequent adjustments are necessary.

Boiler-Burner Units

Boilers especially designed for oil burners are gradually becoming available to the purchaser of this type of equipment. They are used for replacements as well as for new installations. These boilers have more heating surface than the older coal-burning designs. Flue proportions and gas travel have been changed with beneficial results. All questions of firepot design, capacities, efficiencies, etc., have been determined. The selection of the proper size of unit should be a simple process.

Controls

Oil burner controls may be divided into two parts: (a) devices to regulate burner operation so the desired house heating result may be obtained and (b) devices for the safety and protection of the boiler and

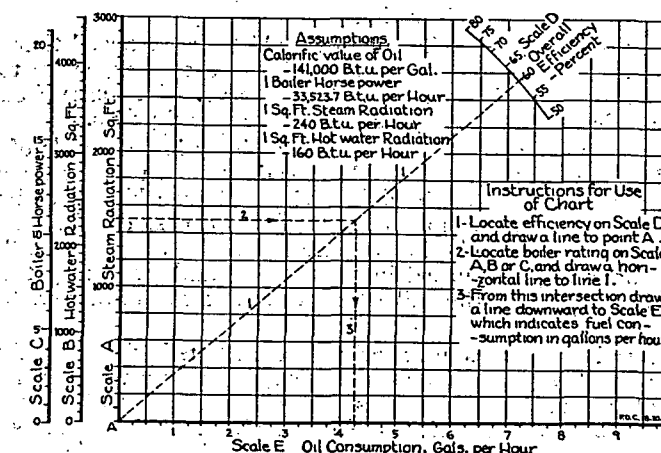


FIG. 7. FULL LOAD RATE OF OIL CONSUMPTION FOR HEATING BOILERS

burner. For control devices generally consult Chapter 14. The room thermostat has recently been improved to provide more frequent burner operation and greater uniformity of room temperature. Class (b) controls comprises a device to shut off the burner if the oil fails to ignite or if the flame should cease due to lack of oil; a device actuated by steam boiler pressure to shut off the burner when the pressure reaches some predetermined value; a device on the boiler to shut off the burner if the water level acts too low for safety or one which automatically feeds additional water to the boiler; a device on warm air furnaces to shut off the burner if the air temperature gets too high; a valve in the oil supply line which automatically closes in the event of fire in or near the cellar; and a device to keep the temperature of the boiler water within certain limits when it is being used to heat domestic hot water. These devices are all tested and approved by the Underwriters' Laboratory of Chicago, Ill., before they are offered to the purchaser. The selection of class (b) devices is made by the oil burner manufacturer.