chamber design is to provide against flame impingement upon either metallic or firebrick surfaces. Manufacturers of oil burners usually have available detailed plans for adapting their burners to various types of boilers, and such information should be utilized.

Controls for oil burner operation, including devices for the safety and protection of a boiler or furnace, are fully described in Chapter 38.

COMMERCIAL AND INDUSTRIAL OIL BURNERS

Oil burning equipment for commercial and industrial applications is usually designed for burning the lower cost heavy fuel oils such as U. S. Commercial Standard Grades Nos. 4, 5, and 6. The viscosity of these oils is much greater than that of the lighter domestic grades and, therefore, the equipment required for satisfactory storage, pumping, and combustion differs greatly from that used in the typical domestic oil burning system.

Both the initial cost and the operating cost of an oil burning system may be affected materially by the characteristics of the industrial fuel oil to be used. These characteristics should, therefore, be given careful consideration when setting up the specifications of the fuel oil for which the system is to be designed.

Classification of Burners

These burners are usually classified according to the method used for atomizing the oil as (1) horizontal rotary cup atomizing, (2) mechanical pressure atomizing, (3) steam atomizing, and (4) air atomizing.

Horizontal Rotary Cup Burner

In this type of burner, oil is delivered into a horizontal cup that is rotated at high speed. As the thin film of oil is spun from the rim of the cup, it enters a cone of high velocity primary air and very effective atomization is obtained. In most applications secondary air for combustion is supplied by natural draft through checkered openings in the floor of the combustion chamber. In some applications, however, the secondary air is admitted through openings surrounding the burner nozzle and may be supplied by forced draft.

The rotary cup burner has been the most popular type in the capacity range from approximately 25 to 500 boiler horsepower. Its principal advantages are that it is a self-contained integral unit; it is readily adaptable to manual, semi-automatic, or fully-automatic control; and the firing rate may be easily modulated through a wide range while maintaining high combustion efficiencies. These burners are frequently used for firing packaged steam generator units.

Mechanical Pressure Atomizing Burner

In this burner oil is atomized by passing it through a specially designed nozzle under pressures of approximately 100 to 250 psig. The air for combustion may be supplied by either natural or forced draft, and is usually admitted through an air register surrounding the burner nozzle or through checkered openings in the floor of the combustion chamber. This burner is popular for marine service and for large capacity multiple installations. It is not readily adapted to fully automatic operation.

Steam Atomizing Burner

High pressure steam is used in this burner for atomizing the oil. Oil is delivered to the nozzle at pressures ranging from approximately 5 to 50 psig, and steam at approximately 50 to 150 psig is admitted to the nozzle by various methods to assist in the atomization. Combustion air is usually supplied by natural draft through checkered openings in the floor of the combustion chamber or through an air register surrounding the nozzle. This burner is relatively low in first cost but is not adapted to fully automatic operation or wide variations in firing rate.

Air Atomizing Burner

The air atomizing burner is similar to the steam atomizing type, except that air under pressure instead of steam is used for atomization. The performance characteristics of the two burners are also similar but higher temperature oil is usually required when using air for atomization.

Preheating of Heavy Fuel Oils

Unlike the lighter grades of fuel oils that can be pumped, atomized, and burned efficiently without prior preheating, the heavier grades of residual fuel oils require conditioning by the application of heat before use. Preheating is employed to reduce the viscosity of the oil so that it can be pumped and atomized properly by the burner. The function of the burner is to atomize the oil and mix it thoroughly with the proper amount of air for prompt ignition and efficient combustion. The optimum viscosity will vary from 100 to 450 seconds Saybolt Universal viscosimeter, with the type of burner and is reached at different temperatures for different grades of oil. The range of atomizing viscosity is about as follows for normal grades of oil:

Type of Burner	Range of Atomizing Viscosities
Mechanical Atomizing	100–300 SSU
Steam Atomizing	200–250 SSU
Rotary Cup Atomizing	250–450 SSU

Table 1 lists temperatures needed to bring various oil viscosities to the proper atomizing levels. These can be used with some variation to suit individual operations.

The correct degree of preheat must be used for each grade of oil. Underheating or overheating affects the terminal viscosity and actually interferes with the atomizing process. Underheated oil is too viscous for proper atomization, resulting in poor combustion, the generation of smoke and soot, and an excessively high oil consumption. Overheated oil, on the other hand, is too fluid for correct atomization and is subject to the same type of poor operating results as the underheated oil.

No. 4 fuel oils, with a maximum viscosity of 125 seconds Saybolt Universal at 100 F, as a rule do not require any preheating before atomization. They are sufficiently fluid at normal ambient temperatures for good burner operation.

No. 5 fuel oils are of two types: a light grade having a viscosity ranging between 150 and 200 seconds Saybolt Universal, that does not require preheating and hence is known as a *cold* No. 5; and a heavier grade having a viscosity ranging between 200 and 800 seconds Saybolt Universal, that requires preheating and hence is termed a *hot* No. 5 oil.

No. 6 fuel oils (also known as Bunker C) always require preheating, as