

prevent the fire from burning too rapidly. In order to obtain the same interval of attention as with other fuels a deep fuel bed always should be maintained when burning coke. The grates should be shaken only slightly in mild weather and should be shaken only until the first red particles drop from the grates in cold weather. The best size of coke for general use, for small fire-pots where the fuel depth is not over 20 in., is that which passes over a 1 in. screen and through a $1\frac{1}{2}$ in. screen. For large fire-pots where the fuel can be fired over 20 in. deep, coke which passes over a 1 in. screen and through a 3 in. screen can be used, but a coke of uniform size is always more satisfactory. Large sizes of coke should be either mixed with fine sizes or broken up before using.

FURNACE VOLUME

The principal requirements for a *hand-fired furnace* are that it shall have enough grate area and correctly proportioned combustion space. The amount of grate area required is dependent upon the desired combustion rate.

The furnace volume is influenced by the kind of coal used. Bituminous coals, on account of their long-flaming characteristic, require more space in which to burn the gases of combustion completely than do the coals low in volatile matter. For burning high volatile coals provision should be made for mixing the combustible gases thoroughly, so that combustion is complete before the gases come in contact with the relatively cool heating surfaces. An abrupt change in the direction of flow tends to mix the gases of combustion more thoroughly. Anthracite requires comparatively little combustion space.

CLASSIFICATION OF OILS

The Commercial Standard Specifications for Fuel Oils (CS 12-40) of the U. S. Department of Commerce are given in Table 7. These specifications conform with *American Society for Testing Materials* Tentative Specifications for Fuel Oils D396-38T.

The specific gravity of oil is of interest in its relationship to the calorific value and these data are given in Table 8.

COMBUSTION OF OIL

With oil, as with any kind of fuel, efficient heat production requires that all combustible matter in the fuel shall be completely consumed and that it shall be done with a minimum of excess air. The combustion of oil is a rather rapid chemical reaction. Excess air provides an over supply of oxygen so that all of the oil will be completely oxidized and thus produce all the heat possible. The use of unreasonable quantities of air in excess of theoretical combustion requirements results in lowered efficiencies due to increased stack losses. Such losses, if not accompanied by unburned products of combustion, may be offset somewhat by increasing the secondary heating surfaces of the heat absorbing medium, boiler or furnace.

Oil is a highly concentrated fuel composed mainly of hydrogen and carbon. In its liquid form oil cannot burn. It must be converted into a gas or vapor by some means. If the excess air is to be kept within efficient limits, air must be supplied in carefully regulated quantities. The air and oil vapor must be thoroughly mixed to get a rapid and complete chemical reaction. The better the mixing, the less excess air will be

TABLE 7. DETAILED REQUIREMENTS FOR FUEL OILS^a

GRADE ^b	FLASH POINT DEG F		POOR POINT DEG F	WATER AND SEDIMENT PER CENT	CARBON RESIDUE PER CENT	ASH PER CENT	DISTILLATION TEMPERATURES DEG F				VISCOSITY SECONDS			
							10 PER CENT POINT	50 PER CENT POINT	END POINT	Max.	Min.	Saybolt Universal at 100 F	Saybolt Fuel at 122 F	Max.
No. 1 Fuel oil—a distillate oil for use in burners requiring a volatile fuel.	Min. 100 or Legal 165*	Max.	0*	Trace	Max. 0.05 on 10% Residue ^d	Max.	410	600	560*					
No. 2 Fuel oil—a distillate oil for use in burners requiring a moderately volatile fuel.	Min. 110 or Legal	Max. 190	10*	0.05	Max. 0.25 on 10% Residue ^d		440	600						
No. 3 Fuel oil—a distillate oil for use in burners requiring a low viscosity fuel.	Min. 110 or Legal	Max. 230	20*	0.10	Max. 0.15 Straight			675	600*			45		
No. 5 Fuel oil—an oil for use in burners requiring a medium viscosity fuel.	Min. 130 or Legal			1.00		0.10							50	40
No. 6 Fuel oil—an oil for use in burners equipped with preheaters permitting a high viscosity fuel.	Min. 150			2.00*										300
														45

^aRecognizing the necessity for low sulphur fuel oils used in connection with heat-treatment, non-ferrous metal, glass and ceramic furnaces and other special uses, a sulphur requirement may be specified in accordance with the following table:

GRADE OF FUEL OIL	SULPHUR, MAX. PER CENT
No. 1	0.5
No. 2	0.5
No. 3	0.75
No. 5	No Limit
No. 6	No Limit

Other sulphur limits may be specified only by mutual agreement between the buyer and seller of these classifications that failure to meet any requirement of a given grade does not automatically place an oil in the next lower grade unless in fact it meets all requirements of the lower grade.

^bLower or higher pour points may be specified whenever required by conditions of storage or use. However, these specifications shall not require a pour point lower than 0 F under any conditions. Blue flame burners carbon residue on 10 per cent residue may be specified to a maximum of 0.12 per cent. This limit may be specified by mutual agreement between the buyer and seller.

^cThe maximum end point may be increased to 590 F when used in burners other than sleeve type blue flame burners.

^dTo meet certain burner requirements the carbon residue limit may be reduced to 0.15 per cent on 10 per cent residue.

^eThe minimum distillation temperature of 600 F for 90 per cent may be waived if A.P.I. gravity is 28 or lower.

^fWater by distillation, plus sediment by extraction. Sum, maximum 2.0 per cent. The maximum sediment by extraction shall not exceed 0.50 per cent. A deduction in quantity shall be made for all water and sediment in excess of 1.0 per cent.