

TABLE 7. DETAILED REQUIREMENTS FOR FUEL OILS^a

GRADE ^b	FLASH POINT, DEG F		POUR POINT, DEG F	WATER AND SEDIMENT PER CENT	CARBON RESIDUE PER CENT	ASH PER CENT	DISTILLATION TEMPERATURES, DEG F			VISCOSITY SECONDS		
	Min.	Max.	Max.	Max.	Max.	Max.	10. Per Cent Point	90. Per Cent Point	End Point	Saybolt Universal at 100 F	Saybolt Fuel at 122 F	Max. Min.
No. 1 Fuel oil—a distillate oil for use in burners requiring a volatile fuel.	100 or Legal	165	15°	Trace	0.05 on 10% Residue ^d		410		560 ^e			
No. 2 Fuel oil—a distillate oil for use in burners requiring a moderately volatile fuel.	110 or Legal	190	15°	0.05	0.25 on 10% Residue ^f		440	600				
No. 3 Fuel oil—a distillate oil for use in burners requiring a low viscosity fuel.	110 or Legal	230	20°	0.10	0.15 Straight			675	600 ^g	55		
No. 5 Fuel oil—an oil for use in burners requiring a medium viscosity fuel.	130 or Legal			1.00		0.10				60	40	
No. 6 Fuel oil—an oil for use in burners equipped with preheaters permitting a high viscosity fuel.	150			2.00 ^h							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. PERCENT
No. 1	0.05
No. 2	0.06
No. 3	0.07
No. 5	0.75
No. 6	No Limit

^bOther sulphur limits may be specified only by mutual agreement between the buyer and seller.
^cIt is the intent 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 it meets all requirements of the lower grade.

^dLower 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.

^eFor use in other than sleeve type blue flame burners carbon residue on 10 per cent residue may be increased to a maximum of 0.12 per cent. This limit may be specified by mutual agreement between the buyer and seller.

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

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

^hA.P.I. gravity is 20° at 60° F.

ⁱWater 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.

TABLE 8. APPROXIMATE GRAVITY AND CALORIFIC VALUE OF STANDARD GRADES OF FUEL OIL

COMMERCIAL STANDARD NO.	APPROXIMATE GRAVITY, RANGE BAUME	CALORIFIC VALUE BTU PER GALLON
1	38-40	136,000
2	34-36	138,500
3	28-32	141,000
5	18-22	148,500
6	14-16	152,000

gas or vapor by some means. If the excess air is to be kept within efficient limits it means that air must be supplied in carefully regulated quantities. The air and oil vapor must be vigorously mixed to get a rapid and complete chemical reaction. The better the mixing, the less excess air that will be needed. The combustion must take place in a space that maintains the temperatures high so the reaction will not be stopped before completion. When equipped with a means of igniting the oil and safety devices to guard against mishaps, the oil burner possesses all of the elements to be efficient and automatic.

CLASSIFICATION OF GAS

Gas is broadly classified as being either *natural* or *manufactured*. Natural gas is a mechanical mixture of several combustible and inert gases rather than a chemical compound. Manufactured gas as distributed is usually a combination of certain proportions of gases produced by two or more processes, and is often designated as *city gas*. Representative properties of gaseous fuels commonly used in domestic heating are presented in Table 9.

Natural gas is the richest of the gases and contains from 80 to 95 per cent methane, with small percentages of the other combustible hydrocarbons. In addition, it contains from 0.5 to 5.0 per cent of CO_2 , and from 1 to 12 or 14 per cent of nitrogen. The heat values varies from 700 to 1500 Btu per cubic foot, the majority of natural gases averaging about 1000 Btu per cubic foot. Table 9 shows typical values for the four main oil fields, although values from any one field vary materially.

Table 9 also gives the calorific values of the more common types of manufactured gas. Most states have legislation which controls the distribution of gas and fixes a minimum limit to its heat content. The gross or higher calorific value usually ranges between 520 and 545 Btu per cubic foot, with an average of 535. A given heat value may be maintained and yet leave considerable latitude in the composition of the gas so that as distributed the composition is not necessarily the same in different districts, nor at successive times in the same district.

COMBUSTION OF GAS

The majority of gas burners utilized in central domestic heating plants are of the Bunsen type and operate with a non-luminous flame. In this type of burner part of the air required for combustion is mixed with the gas as primary air, the air and gas mixture being fed to the burner ports.