

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 SEC/100 F	
	Min.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	Max.	10 Per Cent Point	90 Per Cent Point	End Point	Max.	Saybolt Universal at 100 F	Saybolt Viscosity at 12 F
No. 1 Fuel oil—a distillate oil for use in burners requiring a volatile fuel.	100 or Legal	165	0*	Trace	0.05 on 10% Residuum ^c	0.10	0.05 on 10% Residuum ^c	0.10	0.10	410	600	560*		45	
No. 2 Fuel oil—a distillate oil for use in burners requiring a moderately volatile fuel.	110 or Legal	190	10*	0.05	0.25 on 10% Residuum ^c	0.10	0.25 on 10% Residuum ^c	0.10	0.10	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	0.10	0.15 Straight	0.10	0.10		675	600*			
No. 5 Fuel oil—an oil for use in burners requiring a medium viscosity fuel.	130 or Legal			1.00										50	40
No. 6 Fuel oil—an oil for use in burners equipped with preheaters permitting a high viscosity fuel.	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	0.5
No. 5	0.5
No. 6	No Limit

Other sulphur limits may be specified only by mutual agreement between the buyer and seller.
^bIt 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 in fact it meets all requirements of the lower grade.

*Lower 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.
^cFor use in other than sleeve type blue flame burners carbon residue on 10 per cent residuum may be increased to a maximum of 0.12 per cent. This limit may be specified by mutual agreement between the buyer and seller.
^dThe maximum end point may be increased to 560 F when used in burners other than sleeve type blue flame burners.
^eTo meet certain burner requirements the carbon residue limit may be reduced to 0.11 per cent on 10 per cent residuum.
^fThe flash point shall be not less than 100 F.
^gIf A.P.I. gravity is 28 or higher, the flash point temperature of 600 F for 90 per cent may be waived.
^hWater 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.

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 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 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 becomes 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 dis-

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

tributed is usually a combination of certain proportions of gases produced by two or more processes. 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 value varies from 1000 to 1200 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. However, in any community the variations in gas composition are held within suitable limits so that the performance of approved gas appliances will not be adversely affected.

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