

ring burners, proportional mixers, or compressors, are purchased for assembly in existing equipment, usually by the installer. Furnaces to provide particular atmospheres or for annealing, soaking pits, metal melting, etc. are usually engineered by industrial gas equipment manufacturers.

Burners utilized in industrial equipment often operate at gas pressures higher than encountered in domestic usage. High pressure gas provides flexibility of control required in the production of constant temperatures. In addition, air-gas ratios can be closely maintained under throttling conditions, and heat liberation per cubic foot of combustion space is considerably greater than can be achieved with lower pressures.

A few of the many basic types of burners used are as follows: single-pipe high pressure, proportional mixing, pre-mix, two-pipe high pressure, and atmospheric.

The *single-pipe high pressure burner* system utilizes gas delivered to the orifice of a venturi at pressures from 10 to 50 psig. A constant pressure compressor, sometimes remotely placed, is occasionally used to increase the

TABLE 4. MULTIPLIERS FOR VARIOUS SPECIFIC GRAVITIES
For Use With Table 3

Specific Gravity	Multiplier	Specific Gravity	Multiplier
0.35	1.31	1.00	0.775
0.40	1.23	1.10	0.740
0.45	1.16	1.20	0.707
0.50	1.10	1.30	0.680
0.55	1.04	1.40	0.655
0.60	1.00	1.50	0.633
0.65	0.962	1.60	0.612
0.70	0.926	1.70	0.594
0.75	0.895	1.80	0.577
0.80	0.867	1.90	0.565
0.85	0.841	2.00	0.547
0.90	0.817	2.10	0.535

gas pressure. The velocity of the gas issuing from the orifice entrains primary air which is controlled by an air shutter on the venturi tube. An advantage of this system is that when the gas pressure is reduced (lowering the input) the air-gas ratio will remain constant over a fairly wide range.

In the *proportional mixing burner*, an enclosed type venturi is used and high pressure air is delivered through an orifice. The resulting partial vacuum entrains the gas which is supplied through a zero pressure governor. When the air pressure is reduced, the amount of gas entrained is similarly reduced, thus maintaining a constant air-gas ratio over a wide fuel capacity range.

The *pre-mix burner* system embodies a compressor which mixes air and gas intimately and discharges the mixture through pipes to the burners where it is discharged through orifices and burned. The pre-mix compressor can be remotely installed and the mixture can be closely controlled.

The *two-pipe high pressure burner* system utilizes both air and gas under pressure, both being delivered through orifices and mixed prior to delivery to the burner.

The *atmospheric burner* system is not commonly used. It consists of a burner supplied with gas at a pressure of 2 to 12 in. water. A portion of the air or primary air required for combustion is entrained from the atmosphere by the stream of gas issuing from an orifice, and the air-gas mixture is

delivered through a venturi mixing tube to the burner head and parts. About 40 to 60 percent of the air required for combustion is in the form of primary air and the remainder, known as secondary air, is supplied from the air surrounding the flame.

Each system embodies characteristics essential for certain applications. It is strongly recommended that proper and qualified engineering authorities be consulted prior to the purchase, installation, or operation of industrial gas equipment.

FUEL BURNING RATES

The burning rate for automatic fuel burning devices is determined by the gross heat output required of the boiler, or furnace, to carry the net heating load, plus allowances for system losses and pick-up. General

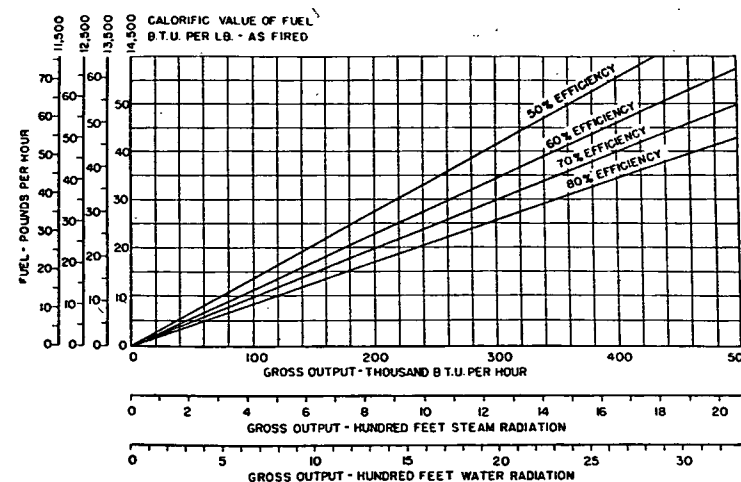


FIG. 21. COAL FUEL BURNING RATE CHART

values for these allowances have been given in preceding text. Detailed information for piping and pick-up allowances for steam and hot water systems, is given in Chapter 16, and for warm air systems, in Chapter 19.

When the gross output, operating efficiency, and heat value of the fuel are known, the required rate of burning can be determined by means of Figs. 21, 22 and 23 for the several fuels.

As the rate of fuel burning is directly proportional to the load for a given efficiency, these charts can be extended by moving the decimal points the same number of digits in both vertical and horizontal scales.

The correct fuel burning rate can be determined directly from the several charts for oil or gas burning installations, as these customarily operate on a strictly intermittent basis. These fuel burning devices usually introduce the fuel at a single fixed rate during the *on* periods, and this rate should be sufficient to carry the gross load. In the case of coal stokers, which are usually capable of variable rates of firing, it is desirable to operate at as low a rate as weather conditions will permit, but the maxi-