should not be judged from the value of the CO_2 in the flue gas without reference to the ultimate CO_2 obtainable. Practical values of CO_2 will usually be from 8 to 14 percent, depending on the gas used.

Ratings for Gas Appliances

Input rating for a gas appliance is established by demonstrating that the appliance can meet the Approval Requirements of the *ASA*. The tests are conducted at the *A.G.A. Laboratories*. Output rating is determined from the approved input and an average efficiency stated in the Approval Requirements, and is the heat available at the outlet.

Sizing Gas-Fired Heating Plants

Although gas-burning equipment usually is completely automatic,

TABLE 1. CAPACITY OF GAS PIPING

Length of Pipe in Feet	Nominal Diameter of Pipe in Inches				
	¾	1	1¼	1½	2
	Capacity—Cu Ft Per Hr with a 0.6 Sp Gr Gas and Pressure Drop of 0.3" Water Column				
15	172	345	750		
30	120	241	535	850	
45	99	199	435	700	
60	86	173	380	610	
75	77	155	345	545	
90	70	141	310	490	
105	65	131	285	450	920
120		120	270	420	860
150		109	242	380	780
180		100	225	350	720

maintaining the temperature of rooms at a predetermined figure, there are some manually controlled installations. In order to overcome effectively the starting load and losses in piping, a manually-controlled gas boiler should have an output as much as 100 percent greater than the equivalent standard radiation which it is expected to serve.

Boilers under thermostatic control, however, are not subject to such severe pick-up loads and consequently, it is possible to use a lower selection factor. For a gas-fired boiler or furnace under thermostatic control, a factor of 20 to 25 percent is usually sufficient for pick-up allowance.

In those installations, in mild climates where 100 percent outside air is used, furnaces should be of larger size in order to provide adequate capacity and quick pick-up under intermittent heating conditions.

The factor to be allowed for loss of heat from piping will vary somewhat, the proportionate amount of piping installed being greater for small installations than for large ones. For selection factors to be added to installed radiation under thermostatic control, see Chapter 15.

Appliances used for heating with gas should bear the approval seal of the *A.G.A. Laboratories* on the manufacturer's nameplate, together with the official input and output ratings. It is not permissible to operate a gas heating unit above its stated rating. It may be necessary to operate below this rating at elevations above 2000 ft, unless the appliance has been tested and approved for operation at altitudes up to 5200 ft, in which case such approval will be shown on the manufacturer's nameplate.

Installations should be made in accordance with recommendations shown in the publications of the *American Gas Association*.

Controls

Temperature controls for gas burners are described in Chapter 38. Some central heating plants are equipped with push-button or other manual control. The main gas valve may be of either the snap action or throttling type. Automatic electric ignition is available.

Sizing of Gas Piping

Piping for gas appliances should be of adequate size, and so installed as to provide a supply of gas sufficient to meet the maximum demand without

TABLE 2. MULTIPLIERS FOR VARIOUS SPECIFIC GRAVITIES
For Use With Table 1

Specific Gravity	Multiplier	Specific Gravity	Multiplier
.35	1.31	1.00	.775
.40	1.23	1.10	.740
.45	1.16	1.20	.707
.50	1.10	1.30	.680
.55	1.04	1.40	.655
.60	1.00	1.50	.633
.65	.962	1.60	.612
.70	.926	1.70	.594
.75	.895	1.80	.577
.80	.867	1.90	.565
.85	.841	2.00	.547
.90	.817	2.10	.535

undue loss of pressure between the point of supply (the meter) and the burner. The size of gas pipe required depends upon the following:

1. Maximum gas consumption to be provided.
2. Length of pipe and number of fittings.
3. Allowable loss in pressure from the outlet of the meter to the burner.
4. Specific gravity of the gas.

To obtain the cubic feet per hour of gas required by the burner, divide the Btu input at which the burner will be adjusted, by the average Btu heating value per cubic foot of the gas.

Capacities of different sizes and lengths of pipe, in cubic feet per hour, with a pressure drop of 0.3 in. of water column for a gas of 0.60 sp gr, are shown in Table 1. In adopting a 0.3 in. pressure drop, due allowance for an ordinary number of fittings was made.

To convert the figures given in Table 1 to capacities for another gas of different specific gravity, multiply the tabular values by the multipliers shown in Table 2.

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