

steam, or temperature of water, that in most cases a factor of 25 per cent is eminently sufficient for pick-up load.

The factor to be allowed for loss of heat from piping, however, must vary somewhat, the proportionate amount of piping installed being considerably greater for small installations than for large ones. Consequently, a selection factor for thermostatically controlled boilers must be variable. Table 1 gives selection factors to be added to the installed steam radiation under thermostatic control. They have been established by experience and are recommended by the *American Gas Association*.

Appliances used for heating with gas should bear the Approval Seal of the *American Gas Association* Testing Laboratory. Installations should be made in accordance with the recommendations shown in the publications of that Association.

RATINGS FOR GAS HEATING APPLIANCES

Since a gas appliance has a heat-generating capacity that can be predicted accurately to within 1 or 2 per cent, and since this capacity is not

TABLE 1. SELECTION FACTORS FOR GAS BOILERS

EQUIVALENT CAST IRON STEAM RADIATION (SQUARE FEET OF 240 BTU EACH)	SELECTION FACTOR (PER CENT)
500	56.0
800	54.0
1,200	51.0
1,600	48.0
2,000	45.0
3,000	42.5
4,000 and over	40.0

affected by such things as condition of fuel bed and soot accumulation, makers of these appliances have an opportunity to rate their product in exact terms. Consequently all makers give their product an hourly Btu output rating. This is the amount of heat that is available at the outlet of a boiler in the form of steam or hot water, or at the bonnet of the furnace in the form of warm air. The output rating is in turn based upon the Btu input rating which has been approved by the *American Gas Association* Testing Laboratory and upon an arbitrary efficiency which has been assigned by that Association.

In the case of boilers, the rating can be put in terms of square feet of equivalent direct radiation by dividing it by 240 for steam, and 150¹ for water. This gives what is called the *American Gas Association* rating, and is the manner in which all appliances approved by the *American Gas Association* Laboratory are rated. To use these ratings it is only necessary to increase the calculated heat loss or the equivalent direct radiation load by an appropriate amount for starting and piping, and to select the boiler or furnace with the proper rating.

¹A value of 160 for the heat-emission of hot-water radiators is used by many engineers. The actual heat emission, however, depends on the temperature of the water and of the surrounding air. See Chapters 6 and 8.

It might be stated at this point that the rating given by the *American Gas Association* Laboratory is not only a safe rating when considered from the standpoint of capacity, but is also a safe rating when considered from the standpoint of physical safety to the owner or caretaker. The rating that is placed upon an appliance is limited by the amount of gas that can be burned without the production of harmful amounts of carbon monoxide. This same limitation applies to all classes of gas-consuming heating appliances that are tested and approved by the Laboratory. Gas boilers are available with ratings up to 14,000 sq ft of steam, while furnaces with ratings up to about 500,000 Btu per hour are available.

CONTROL FEATURES

One feature of the piping installation that adds to the satisfactory service rendered by gas boilers is provision for adequate and rapid venting of the air from steam heating systems. If air leaks into the steam distribution system during the period that the gas is turned off, and then vents out slowly when the thermostat calls for heat, the result will be a further cooling of the premises between the time that the thermostat calls for heat and the time that steam reaches the radiators. A freely venting steam or vapor system gives maximum economy and minimum temperature variation. When gas boilers are attached to existing heating plants, it is good practice to check the effectiveness of the venting devices and if necessary, replace them with more effective ones that will prevent the return of air into the heating system, and also to check the tightness of the piping.

On account of the ease and effectiveness with which the fuel can be controlled, gas-burning appliances are particularly adaptable to full automatic control. Standard equipment on a steam boiler generally includes provision for control through a room temperature thermostat, a steam pressure regulator and either a device by means of which the water in the boiler is automatically maintained at the proper level or a device which shuts off the gas in the event that the water level becomes too low. Practically all gas boilers are or may be equipped with automatic safety pilots which shut off the gas if the pilot flame is too low.

Water boilers are adapted to operation under thermostatic room temperature control and are also provided with water temperature control equipment. Warm air furnaces can be under the control of thermostats in the spaces being heated, as well as thermostats located in the heat ducts for the purpose of preventing unpleasantly hot air reaching the heated spaces. Variations in the pressure under which the gas is supplied to the appliance are controlled by means of a gas-pressure regulator. This is an essential part of practically all makes of gas-burning heating appliances, in fact a gas-pressure regulator is required by the *American Gas Association* on all approved gas boilers, warm air furnaces (except floor furnaces) and unit heaters.

CROSS-CONNECTING COAL AND GAS BOILERS

Frequently, when a coal boiler is already installed in a home, it is expedient to leave the coal boiler in place, and to cross-connect the gas boiler with it. Where gas heating is new to the community, it pro-