

## TERMINOLOGY

When any question arises concerning *size, rating and capacity*, it becomes particularly desirable that certain terms may be understood so that all data may be readily translated into comparable form. Among these are the following:

*Rate of combustion* is the amount of fuel in pounds burned per hour per square foot of grate surface.

*Draft requirement*, by which is meant the difference of pressure required to overcome the resistances to flow of gases through the fuel bed, flues, ashpit doors, smoke pipe, chimney, etc. This is expressed in inches of water. The data given by manufacturers generally covers the requirement of the boiler alone and does not include smoke pipe, chimney, etc., which should be added for according to conditions.

*Heating surface*, is any portion of the surface of the boiler which comes into direct contact with heated fuel, flame, or the gases of combustion.

*Prime or direct heating surface*, is that part of the total surface on which the fire shines or which comes into contact with heated fuel.

*Secondary or indirect heating surface*, is that part of the total surface which only comes into contact with the gases of combustion.

## NUMBER OF UNITS

Reference has been made to the possibility of installing two or more boilers of proportionately less capacity in lieu of one sufficiently large to care for the whole load. Conditions often arise where the amount of installed load requires a draft with one boiler that calls for a height of stack that is not desirable from an artistic point of view. In such cases it is often better to install two or more boilers, instead of one, with especial regard to chimney conditions which will allow one boiler to be run at an overload at times and all boilers used only in the most extreme winter weather.

## IMPORTANCE OF DRAFT

The capacity a boiler is capable of developing depends more upon the amount of draft available than upon any other factor. Assuming that a chimney is smoke tight and well built according to the Ordinance for Construction of Chimneys, 1921 (recommended by the *National Board of Fire Underwriters* and approved by the Society), the intensity of the draft depends upon the height of the chimney, and the quantity or amount of draft depends principally upon the effective area of the chimney.

Size of boiler plant is not the controlling factor of chimney height, but the desired rate of combustion is. There may be the same rate of burning in a small as in a large boiler so that the same height of chimney should be provided in one case as in the other, but the relative chimney areas will, of course, not be the same since that factor is dependent on the quantity of gas to be carried off. The mistake is not infrequently made of assuming that a low chimney will suffice for a small installation, and that a greater height would be needed for a larger plant, although it would be necessary to burn fuel at the same rate in either case.

According to their height, heating plant chimneys are divided into three classes, the erratic, uncertain and reliable. Chimneys less than 36 ft. high are erratic in their action. The head produced by such a low height

is so small that the least unfavorable condition or interference practically puts the chimney out of commission.

At best the head produced by chimneys up to 64 ft. in height is so small that the draft is frequently affected by surrounding conditions making the draft a doubtful one. Chimneys over 64 ft. in height are not usually so affected, because as a rule the chimney is designed by an engineer and must be well built to sustain such a heavy load and the height is such as to produce considerable head or force to offset unfavorable weather conditions, etc. Chimneys in this class produce about 0.009 in. draft per ft. of height in zero weather with 600 deg. in the stack according to the formula:

$$P = H \left( \frac{7.6}{T_o} - \frac{7.9}{T_s} \right)$$

where

$P$  = draft pressure in inches of water.

$H$  = height of chimney in feet.

$T_o$  = absolute temperature of outside air.

$T_s$  = absolute temperature of stack gases.

For low-pressure heating boilers, water heaters and warm air furnaces conservative modern practice in the matter of chimney sizes is in accordance with the accompanying schedule, Table 1:

TABLE 1. CHIMNEY SIZES

| WARM AIR FURNACE CAPACITY IN LEADER PIPE SQ. IN. | STEAM BOILER CAPACITY SQ. FT. OF RADIATION | HOT WATER HEATER CAPACITY SQ. FT. OF RADIATION | NOMINAL DIMENSIONS OF FIRE CLAY LINING IN. | RECTANGULAR FLUE                                 |                     |                        | ROUND FLUE                    |                        |                          |
|--------------------------------------------------|--------------------------------------------|------------------------------------------------|--------------------------------------------|--------------------------------------------------|---------------------|------------------------|-------------------------------|------------------------|--------------------------|
|                                                  |                                            |                                                |                                            | Actual Inside Dimensions of Fire Clay Lining In. | Actual Area Sq. In. | Effective Area Sq. In. | Inside Diameter of Lining In. | Effective Area Sq. In. | Height in Ft. from Grate |
| 790                                              | 590                                        | 973                                            | 8½x13                                      | 7x11½                                            | 81                  | 70                     | 10                            | 79                     |                          |
| 1000                                             | 690                                        | 1140                                           |                                            |                                                  |                     |                        |                               |                        |                          |
|                                                  | 900                                        | 1490                                           | 13x13                                      | 11¼x11¼                                          | 127                 | 99                     |                               |                        |                          |
|                                                  | 900                                        | 1490                                           | 8½x18                                      | 6¾x16¼                                           | 110                 | 100                    | 12                            | 113                    |                          |
|                                                  | 1100                                       | 1820                                           |                                            |                                                  |                     |                        |                               |                        |                          |
|                                                  | 1700                                       | 2800                                           | 13x18                                      | 11¼x16¼                                          | 183                 | 156                    | 15                            | 177                    |                          |
|                                                  | 1940                                       | 3200                                           |                                            |                                                  |                     |                        |                               |                        |                          |
|                                                  | 2130                                       | 3520                                           | 18x18                                      | 15¾x15¾                                          | 248                 | 195                    |                               |                        |                          |
|                                                  | 2480                                       | 4090                                           | 20x20                                      | 17¼x17¼                                          | 298                 | 234                    | 18                            | 254                    |                          |
|                                                  | 3150                                       | 5200                                           |                                            |                                                  |                     |                        | 20                            | 314                    |                          |
|                                                  | 4300                                       | 7100                                           | 20x24                                      | 17x21                                            | 357                 | 278                    |                               |                        |                          |
|                                                  | 4600                                       | 7590                                           | 24x24                                      | 21x21                                            | 441                 |                        |                               |                        |                          |
|                                                  | 5000                                       | 8250                                           |                                            | 24x24*                                           | 576                 | 380                    | 22                            | 380                    |                          |
|                                                  | 5570                                       | 9190                                           |                                            |                                                  |                     |                        | 24                            | 452                    |                          |
|                                                  | 5580                                       | 9200                                           |                                            |                                                  |                     |                        |                               |                        |                          |
|                                                  | 6980                                       | 11500                                          |                                            | 24x28*                                           | 672                 | 468                    | 27                            | 573                    |                          |
|                                                  | 7270                                       | 12000                                          |                                            | 28x28*                                           | 784                 | 531                    |                               |                        |                          |
|                                                  | 8700                                       | 14400                                          |                                            |                                                  |                     |                        |                               |                        |                          |
|                                                  | 9380                                       | 15500                                          |                                            | 30x30*                                           | 900                 | 616                    | 30                            | 707                    |                          |
|                                                  | 10150                                      | 16750                                          |                                            | 28x32*                                           | 896                 | 635                    | 33                            | 855                    |                          |
|                                                  | 10470                                      | 17250                                          |                                            |                                                  |                     |                        | 36                            | 1018                   |                          |
|                                                  | 11800                                      | 19500                                          |                                            |                                                  |                     |                        |                               |                        |                          |
|                                                  | 14700                                      | 24300                                          |                                            |                                                  |                     |                        |                               |                        |                          |
|                                                  | 17900                                      | 29500                                          |                                            |                                                  |                     |                        |                               |                        |                          |

\*Dimensions below are for unlined rectangular flues.

See also Code of Minimum Requirements for Heating and Ventilation of Buildings.

As height necessary is dependent upon the draft requirements of the heating plant, these factors should be known before height can be accurately determined.