fan draws air through, and (*b*) the *blow-through type*, in which the fan blows air through the heater.

Unit heaters are available in any combination of the three preceding general classifications. For example, the steam or hot water type may be secured with either the propeller or centrifugal type of fans, and in either the draw-through or blow-through type.

Unit heaters also vary in other minor respects. For example, steam and return inlets and outlets may be located on the top and bottom respectively or on the same side of the unit. Some units are supported by the piping and some have independent supports. The heating surface of steam or water type units is generally made up of a non-ferrous tube-and-fin assembly; or it may be fabricated of steel, or cast in steel.

Application of Unit Heaters

Unit heaters are used principally for commercial and industrial applications such as garages, factories, laboratories, etc. They may also be used for heating finished rooms, if properly applied and concealed and if some consideration is given to the problem of noise.

Unit heaters may also be adapted to a number of industrial processes, such as drying and curing, in which the use of heated air in rapid circulation with uniform distribution is of particular advantage. They may be used for moisture absorption, such as fog removal in dye houses, or for the prevention of condensation on ceilings or other cold surfaces of buildings in which process moisture is released. When such conditions are severe, it is necessary that the unit heaters draw air from outside in enough volume to provide a rapid air change and that they operate in conjunction with ventilators or fans for exhausting the moisture-laden air. See discussion of condensation in Chapter 6.

There are three major factors to consider in the application of unit heaters, namely: (1) location of unit, (2) air distribution, and (3) heating medium.

There are a variety of applications which are favorable to the use of *electric unit heaters*. For supplemental heat in residence bath rooms, for the heating of ticket booths, watchmen's offices, factory offices, locker rooms and other isolated rooms scattered over large areas, their use is peculiarly adaptable. They are particularly useful in isolated and unattended pumping stations or pits where they may be thermostatically controlled to prevent freezing temperatures.

Gas fired unit heaters find application in industrial plants, offices, stores, garages, in fact in almost every location where steam type units are used. The installation cost of gas fired units is usually less than that of a type requiring that a new boiler be installed.

Oil fired unit heaters are used in industrial plants, garages and commercial buildings.

Coal fired unit heaters are of finned, welded steel, or cast-iron construction and equipped with centrifugal blowers. They are usually stoker-fired to insure proper firing of fuel. They are used principally in large industrial plants such as foundries or assembly plants, and provide a very economical source of heat, both from the installation and the operating standpoint.

Outlet Velocities

Outlet velocities of unit heaters vary from about 400 to 2500 fpm depending upon the type of unit and the distance to which the air is to be

projected. Noise and drafts must be considered in the choice of air velocities, since both increase with increase of air velocity.

Velocities and decibel ratings for the various types of unit heaters illustrated in Figs. 1, 2, 3 and 4 are given in Table 1.

In the selection of unit heaters it is important not to exceed the throw for which the unit was designed.

These are dependent to a marked degree on the temperature of air leaving the heater as well as upon velocities. See discussion under heading of Inlet, Outlet, and Space Temperatures with Unit Heaters.

Air Outlets

In order to direct the air to points desired and to diffuse the air to avoid drafts, it is common practice to equip unit heaters with directional outlets, adjustable louvers or fixed types of diffusers.

TABLE 1. OUTLET VELOCITIES, DISTANCE OF BLOW AND DECIBEL RATINGS FOR VARIOUS TYPES OF UNIT HEATERS

TYPE OF UNIT HEATER	OUTLET VELOCITIES FPM	DISTANCES OF BLOW—FT	DECIBEL RATING
Centrifugal Fan	1500–2500	20–200	34–90
Horizontal Propeller Fan	400–1000	30–100	26–84
Vertical Propeller Fan	1200–2200	70	50–82

RATINGS OF UNIT HEATERS

It is standard practice to rate unit heaters on the basis of the amount of heat delivered by the air in Btu per hour above an entering air temperature of 60 F. This applies to all types of unit heaters, the steam or hot water type, the electric type and the direct fired type. There are, however, other factors which must be taken into account, especially when an attempt is made to compare one type of heater with another. These are the temperature of the heating element and the velocity of air through it. Consideration is given to these factors in the discussion of ratings for each type of unit heater in the following paragraphs.

Ratings for Steam Type

The rating of steam type unit heaters has been standardized by a code [2] in which the following items are the basis of rating: dry saturated steam at 2 psig pressure (29.92 in. Hg barometric pressure) at the heater coil; air at 60 F entering the heater; and heater operating free of external resistance to air flow.

The capacity of a heater increases as the steam pressure increases, and decreases as the entering air temperature increases. The heating capacity for any condition of steam pressure and entering air temperature other than standard may be calculated approximately from any given rating by the use of factors in Tables 2 and 3. Table 2 is used for the blow-through type and Table 3 for the draw-through type of unit.

Ratings for Hot Water Type

A standard for the rating of hot water type unit heaters has also been established by code [3] in which the following items are the basis of rating: