

Industrial centrifugal fan units are applied where heating capacities and space volumes are large, or where filtration of the heated air, operation against static resistance, or the introduction of outdoor air are required. Down-blow or horizontal-blow units may be used, depending on the requirement.

Cabinet unit heaters are used for applications in which a more attractive appearance is desired. They are suitable for free delivery or low static pressure duct applications, they may be equipped with filters, and can be arranged to discharge either horizontally, or vertically up or down.

Location for Proper Heat Distribution

Location of the units for proper heat distribution is of utmost importance in the application of unit heaters. In general, the units must be selected, located, and arranged so as to provide complete heat coverage and at the same time maintain acceptable air motion and temperature in the working or occupied zone. Proper application depends on a number of factors: the size, number, type and direction of blow of the units, the mounting height, outlet velocity, outlet temperature, air volume, and the type of directional outlet employed. Many of these factors are interrelated, and manufacturers therefore publish data for specific units, showing heat coverage and mounting heights for various outlet velocities and outlet arrangements. Such data should normally be consulted in selecting unit heaters for a particular application.

The mounting height may be governed by space limitations or by the presence of equipment such as display cases or machinery. Both noise and air velocity in the occupied zone generally increase with increased outlet velocities and must therefore be considered.

The blow is dependent to a marked degree on the temperature of air leaving the heater as well as upon its velocity and volume. Increased final temperature will reduce the area of heat coverage and the mounting height. Care must be exercised in the application of down-blow unit heaters. The higher the mounting height, the lower must be the outlet temperature of the air leaving the heater, in order that the heated air will be forced down into the occupied zone.

Since the outlet temperature of air from a unit heater increases with the temperature of the heating medium, unit heaters for high pressure steam or high temperature hot water should be designed to produce approximately the same leaving air temperature as would be obtained from a lower temperature heating medium.

In order to obtain the desired air distribution and heat diffusion, unit heaters are commonly equipped with directional outlets, adjustable louvers, or fixed types of diffusers. For a given unit with a given discharge temperature and outlet velocity, the mounting height and heat coverage can vary widely with the type of directional outlet, adjustable louver, or diffuser employed.

Other factors which may influence the heat coverage must also be considered. Obstructions, such as columns, beams, partitions, or machinery, either in the discharge air stream or in the approach area to the unit, can reduce the heat coverage substantially. The presence of strong drafts or other air currents will also reduce the coverage. Exposures such as large glass areas or outside doors, especially on the windward side of the building, require special attention, and units should be arranged so as to blanket such exposures with a curtain of heated air which will intercept the cold drafts.

For area heating, horizontal-blow unit heaters in exterior zones should be located so as to blow along the exposure or

toward it at a slight angle. Where possible, multiple units should be arranged so that the discharge air streams support each other and create a general circulatory motion in the space. Interior zones under exposed roofs or skylights should be completely blanketed. Down-blow units should be arranged so that the heated areas from adjacent units overlap slightly, so as to provide complete coverage.

For spot heating of individual spaces in larger unheated areas, single unit heaters may be employed, but allowance must be made for the inflow of unheated air from adjacent spaces and the consequent reduction in heat coverage. Isolation of such spaces by partitioning or enclosure is always desirable, from a heating standpoint.

Horizontal unit heaters should have discharge outlets located well above head level, and both horizontal and vertical units should be so applied that the heated air stream will be delivered to the occupied zone at temperatures and velocities which are not objectionable. Where possible, units should be located so that the discharge air flow is into open spaces, such as aisles, and not directly on the occupants.

Manufacturers' catalogs usually give suggestions for the best arrangements of various unit heaters, recommended mounting heights, heat coverages for various outlet velocities, final temperatures, and directional outlets.

Sound Level

Consideration must be given to the problem of the noise generated by unit heaters, if they are applied in spaces having a requirement for low sound levels. All unit heaters generate some noise, and whether or not that noise will be acceptable depends upon the type of space in which it is applied. For example, units with noise levels acceptable in a manufacturing plant might be too noisy for use in a show-room. A unit heater for a particular application must therefore be selected for satisfactory sound level as well as for adequate heating capacity and proper heat distribution.

Ratings of Unit Heaters

It is standard practice to rate all types of 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.

Steam. Rating of steam unit heaters has been standardized by a code¹ in which the following items are the basis of rating: dry saturated steam at 2 psig pressure at the heater coil, air at 60 F (29.92 in. Hg barometric pressure) 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 the entering air temperature other than standard may also be determined by means of a standard procedure prescribed by this code.

Hot Water. A standard for the rating of hot water type unit heaters has also been established by a code² in which the following items are the basis of rating: entering water at 200 F, water temperature drop 20 F entering air at 60 F (29.92 in. Hg barometric pressure), and heater operating free of external resistance to air flow. Variations in entering water temperature, entering air temperature, and water flow rate will affect capacity. This code prescribes a method of translating the heating capacity, as obtained under test conditions, to other conditions of air and water temperature.

Gas-fired. Gas-fired unit heaters are rated in terms of both input and output, in accordance with the approval requirements of the American Gas Association.

Unit Ventilators and Unit Heaters

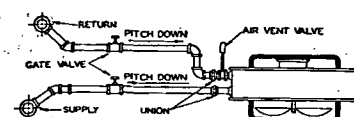


Fig. 15 Connection of Vertical Unit Heater to Hot Water System

Oil-Fired. Ratings of oil-fired unit heaters are based on heat delivered at heater outlet in Btu per hour.

Electric. Electric unit heaters are rated on the energy input to the heating element, expressed in terms of kilowatts, or Btu per hour.

Effect of Resistance Upon Capacity. Unit heaters are customarily rated as free delivery type units. If outside air intakes, air filters, or ducts on the inlet or discharge are used, a reduction in air and heating capacity will result, because of this added resistance to air flow, unless compensating changes are made in fan speed. This reduction in capacity will depend upon the characteristics of the heater, and on the type, design, and speed of the fans, so that no specific percentage reduction can be assigned for all heaters at a given added resistance. The heat output to be expected under other than free delivery conditions should be secured from the manufacturer.

Effect of Inlet Temperature. Changes in entering air temperature will influence the total heating capacity in most unit heaters and the final temperature in all units. Since many unit heaters are located some distance from the occupied zone, consideration should be given to the possible differences in temperature of the air actually entering the unit from that being maintained in the heated area. This is especially true with down-blow unit heaters. In general, the temperature gradient (temperature difference per foot of elevation) when using unit heaters is less than that when using gravity heating units.³

Higher velocity units and units with lower discharge air temperature will maintain lower temperature gradients than units with higher discharge temperatures. Valve-controlled or bypass-controlled units employing continuous fan operation will maintain lower temperature gradients than will units employing intermittent fan operation. Directional control of the discharged air from a unit heater can also be an important factor in effecting satisfactory distribution of heat and in reducing floor-to-ceiling temperature gradients.

When some outdoor air is introduced, the temperature of the mixture of outdoor and recirculated air must be calculated and used as the entering air temperature at the heater. For recirculating heaters located at the floor, or with intakes

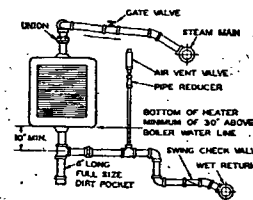


Fig. 16 Unit Heater Connection to Low-Pressure Steam Closed Gravity System

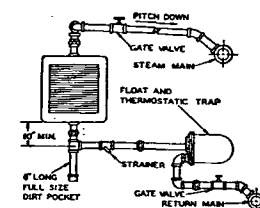


Fig. 17 Unit Heater Connection for Low-Pressure Steam Open Gravity or Vacuum Return System

at the floor, the temperature of air entering the heater should be assumed to be the same as that to be maintained in the room itself.

Automatic Control of Unit Heaters

The controls for a steam or hot water unit heater can either provide (1) on-off operation of the unit fan or (2) continuous fan operation with modulation of heat output.

For on-off operation, a room thermostat is used to start and stop the fan motor. A limit thermostat, often strapped to the supply or return pipe, prevents fan operation in the event that heat is not being supplied to the unit.

Continuous fan operation eliminates the intermittent blasts of hot air resulting from on-off operation, as well as the stratification of temperature from floor to ceiling, which often occurs during the off periods. In this arrangement, a proportional room thermostat controls a valve modulating the heat supply to the coil or a bypass around the heating element. A limit thermostat or auxiliary switch stops the fan when heat is no longer available.

Control of direct-fired and electric units is usually accomplished by intermittent operation of the heat source under control of the room thermostat, with a separate fan switch to run the fan when heat is being supplied. For a more general discussion of automatic control, refer to Chapter 13.

Unit heaters may be used in summer as a means of providing air motion. In such cases, the source of heat is shut off and the thermostat is provided with a bypass switch that will permit fan operation independently of the controls.

Piping Connections For Unit Heaters

Piping connections for steam unit heaters are similar to those for other types of fan blast heaters. The piping of unit heaters must conform strictly to the system requirements, while at the same time permitting the heaters to

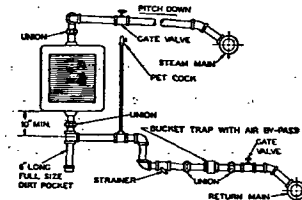


Fig. 18 Unit Heater Connection to High-Pressure Steam System