*Determine Cooling Load on Air Washer*

Heat removed, outside air = 470 ($h_0 - h_3$) = 470 (38.46 − 24.4) = 6600 Btu per min

Heat removed, return air = 1010 ($h_1 - h_3$) = 1010 (31.51 − 24.4) = 7180 Btu per min

Total 13,780 Btu per min

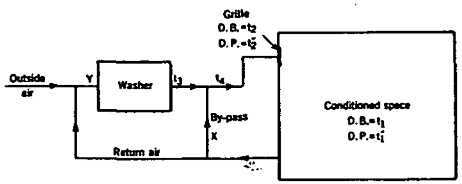
Refrigerating effect = 13,780 ÷ 200 = 68.9 tons.

*Determine Reheating Required*

$H = Wc_p\,(t_2 - t_3)$

$= 1480 \times 0.24\,(68 - 57) = 3910$ Btu per minute = 234,600 Btu per hour.

*Solution. With By-Pass*




*where*

$x$ = air to be by-passed, pound per pound total air.
$y$ = air passed through washer, pound per pound total air.
$t_4$ = dry-bulb temperature after mixing with by-passed air, degrees Fahrenheit.
$t_4$ = $t_2$ if no temperature rise in duct is assumed.

*Determine Amount of By-Pass Air and Saturation Temperature Leaving Washer*[4]

$$t_1x + t_3y = t_4$$
$$t_1''x + t_3y = t_2''$$

$$80x + t_3y = 68$$
$$60x + t_3y = 57$$

$$20x = 11$$
$$x = 0.55$$
$$y = 1 - 0.55 = 0.45$$

$$80 \times 0.55 + 0.45t_3 = 68$$
$$t_3 = 53.3\text{ F}$$

*Determining Cooling Load on Washer*

Air through washer = 0.45 × 1480 = 665 lb per min

Outside air = 470 lb per min

Return air through washer = 195 lb per min

Heat removed, outside air = 470 ($h_0 - h_3$) = 470 (38.46 − 22.13) = 7680 Btu per min

Heat removed, return air = 195 ($h_1 - h_3$) = 195 (31.51 − 22.13) = 1830 Btu per min

Total 9510 Btu per min

Refrigerating effect = 9510 ÷ 200 = 47.55 tons

Reheating—None.

*Note:* The Revised Bulkeley Psychrometric Chart and Table 6, Chapter 1 were used in the solution of these problems.

[4]For derivation of these simultaneous equations see page 190 of THE GUIDE 1937.



Chapter 22

# UNIT HEATERS, UNIT VENTILATORS, UNIT HUMIDIFIERS

***Unit Heaters, Ratings, Unit Ventilators, Applications, Window Ventilators, Unit Humidifiers, Types of Units***

IN other chapters, descriptions are given of heating, cooling, ventilating, humidifying, and dehumidifying systems. The success of such systems has led to the production of factory-assembled equipment employing a majority of the principles of these complete systems. As a result, present day practice involves the use of unitary equipment in the majority of installations where capacity and application demands are within the limits of such units. Thus unit heaters, unit ventilators, and unit humidifiers described in this chapter, and cooling units, unit air conditioners, and attic fans described in Chapter 23 have come to occupy a place of their own in the industry.

## Unitary Equipment

Unitary equipment was first applied in units of small capacity but increased experience in this field has led to an ever widening range of capacities and applications. In general a *unit* may be defined as a factory-made encased assembly of the functional elements indicated by its name, such as unit heater, unit ventilator, etc. These units are shipped substantially complete or built and shipped in sections so that the only field work necessary is the assembling together of the sections, without resorting to any field fabrication.

A unit may be complete in itself, employing its own direct means of air distribution and source of heating, in which case it thus represents a complete self-contained unit. Or it may be coupled with separate means of air distribution such as duct work and outlets, in which case it will still be considered as a unit system, as contrasted with the generally accepted term of a field fabricated central station system. The manufacturer of the unit is responsible for the output and performance of the unit under rated conditions, whereas the contractor installing the complete unitary system is normally held responsible for the performance of the complete system.

Unit equipment justifies its existence due to the following features:

1. Lower cost per unit capacity. Standardized design and volume production makes possible low cost factory assembly thereby eliminating individual design and handling of every part for each installation.