

minus the slip. In rotary and jet pumps, however, it is not usually possible to calculate displacement volumes nor are volumetric efficiencies of these pumps known. Tests are therefore necessary in order to ascertain the amount of air the pump will handle. One method is by means of orifices one-eighth of an inch thick with sharp edges. Orifices having varying diameters of openings are placed in the return line and the vacuum which the pump will produce against each orifice is recorded. In this way the capacities may be determined at several points throughout the operating range of the pump and a characteristic curve plotted. Fig. 1 may be used for approximating the volume of air which can be

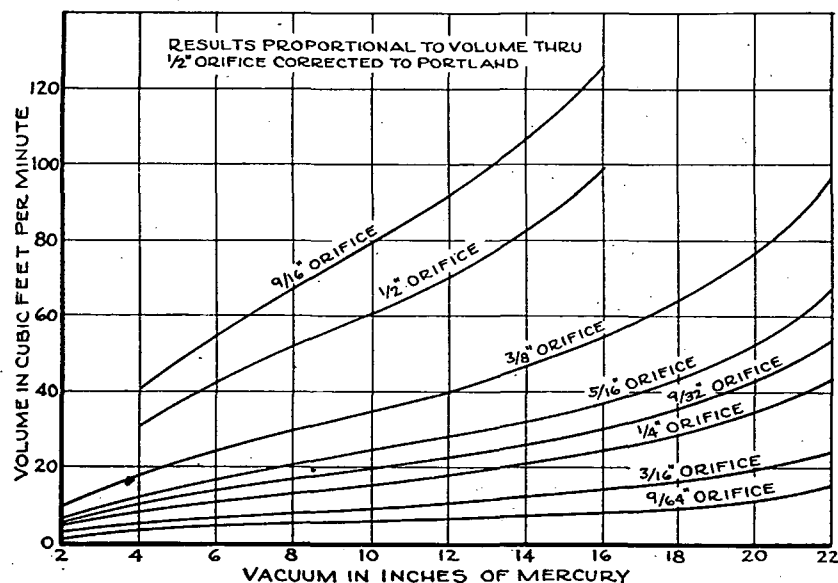


FIG. 1. VOLUME OF AIR IN CUBIC FEET PER MINUTE THROUGH ORIFICES FOR VARIOUS DEGREES OF VACUUM^a

^aThe curves for $\frac{1}{2}$ in. and $\frac{3}{8}$ in. orifices are based on tests conducted on thin plate, $\frac{1}{8}$ in. thick orifices with sharp edges. The volumes for the other orifices are estimated from these two curves. All volumes are based on the vacuum indicated. The volume corresponds to the displacement multiplied by the volumetric efficiency of a reciprocating unit.

handled with various sizes of orifices and degrees of vacuum. It should be noted that the volumes given are measured at the vacuum referred to and are not in terms of free air per minute. The air volume thus shown in Table 3 corresponds to the net volume which, in the case of a reciprocating pump, would be the displacement times the volumetric efficiency. With some types of pumps the air capacity is decreased if the pump is discharging the condensate against a head. Accordingly, when making such a test for vacuum the water capacity of the pump in gallons per minute against some specified head should be stated.

Water Capacity. The water capacity of vacuum heating pumps should be based on not less than $\frac{3}{8}$ lb of condensate per hour per square foot of equivalent cast-iron direct radiation with condensate at a temperature of

180 F when the pump is delivering the rated capacity of condensate against the specified gage pressure at the discharge of the pump. In some types of pumps the air capacity is diminished at the maximum rate of discharge of condensate. Hence, any statement regarding the water capacity should include a simultaneous reading of the orifice size and the vacuum maintained. In estimating the water capacity no additional allowance need be made for covered mains or risers, but exposed mains or risers used as heating surfaces should be included in computing the equivalent square feet of direct radiation.

TRAPS

Traps are used for draining the condensate from radiators, steam piping systems, kitchen equipment, laundry equipment, hospital equipment, drying equipment and many other kinds of apparatus. The usual function of a trap is to allow the passage of condensate and to prevent the passage of steam. In addition to these functions, traps are frequently required to allow the passage of air as well as condensate. Traps are also required to allow the passage of air and to prevent the passage of either water or steam, or both.

In addition, traps are used for returning condensate either by gravity, by steam pressure, or by both, to a boiler or other point of disposal. Also for lifting condensate from a lower to a higher elevation, or for handling condensate from a lower to a higher pressure.

The fundamental principle upon which the operation of practically all traps depends is that the pressure within the trap at the time of discharge shall be equal to, or slightly in excess of, the pressure against which the trap must discharge, including the friction head, velocity head and static head on the discharge side of the trap. If the static head is in favor of the trap discharge it is a minus quantity and may be deducted from the other factors of the discharge head.

Traps may be classified according to the principle of operation as (1) float, (2) bucket, (3) thermostatic, or (4) tilting traps.

Float Traps. A discharge valve is operated by the rise and fall of a float due to the change of water level in the trap. When the trap is empty the float is in its lowest position, and the discharge valve is closed. A gage glass indicates the height of water in the chamber.

Unless float traps are well made and proportioned there is danger of considerable

TABLE 3. WATER AND AIR CAPACITIES FOR VACUUM HEATING PUMPS
(Air and Water at 70 F. Pressure, 10 lb. Vacuum, 10 in.)

RATING (EDR)	WATER CAPACITY (GPM)	AIR CAPACITY AT 10 IN. OF MERCURY (CFM)
2500	4	3
5000	9	3
10,000	14	6
16,000	22	9
26,000	35	15
40,000	60	19
65,000	90	34
100,000	140	50