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No details are minor

The fundamental ingredient of a successful system design is the recognition of all parameters relating to the system to be designed. Assuming these parameters are properly and successfully identified and satisfied, the complete success of the design then depends upon what might be considered a second-order requirement; *attention to design details*. It is at this stage in the development that the designer must decide upon the extent of the detail included in the construction documents vis-a-vis the skills of the installing mechanics or contractor. It is likely that as many operating deficiencies in mechanical systems have resulted from an overly optimistic judgment of these available skills as from any other singular reason.

This is not to criticize the level of skills of the installing mechanics, but rather to recognize that as the machinery and systems become more and more complex, the design profession must assume an ever-increasing responsibility to address the construction details.

Simple examples cited

One simple example of such detail is the method of installing a thermometer well in a pipe. It is not unusual to find wells two inches long installed in a coupling that is well in excess of that length, thus holding the sensing insert totally out of the fluid system (the same is true of temperature controller wells). The error introduced by this detail may be insignificant where there is a considerable temperature difference between the fluid being sensed and the surroundings, such as with a heating water system at 220 F. But as the temperature differential decreases, as is the case for chilled water or condenser water systems, the error becomes most significant!

Other common problems found in the method of installation of such wells are thermometers located such that they cannot be read or wells in a position such that they cannot hold the heat-conducting fluids.

Another example of such detail is the method of connecting condensate drain lines from cooling coil drain pans. The lack of attention to this seemingly unimportant detail has been responsible for extensive damage to countless ceilings, sometimes presenting an unsolvable problem after the fact if adequate space was not provided in the original construction for proper trapping of the air flows through the piping.

If the interior of the condensate drain pan were at the same pressure as the drain outlet, there would, of course, be no problem—it would simply be a matter of gravity drainage of the water. However, since the drain pan is generally at a pressure greater or less than the drain line outlet, the pressure differential motivates a flow of air through the open pipe. The fluid dynamics relating to the effect of this air flow (in either direction) on condensate drainage from the pan and through the piping system is so complex that its results cannot in most cases be anticipated. To reduce this complex problem to a manageable level of understanding, it is common practice to provide a water seal trap simply to stop the air flow. The design problem, then, reduces to the proper design of the trap.

Design drain trap properly

Probably the most troublesome drain deficiencies have been with draw-through type units, where the condensate drain pan is on the fan inlet side and is thus at a negative pressure with respect to the surroundings. Figure 8-1

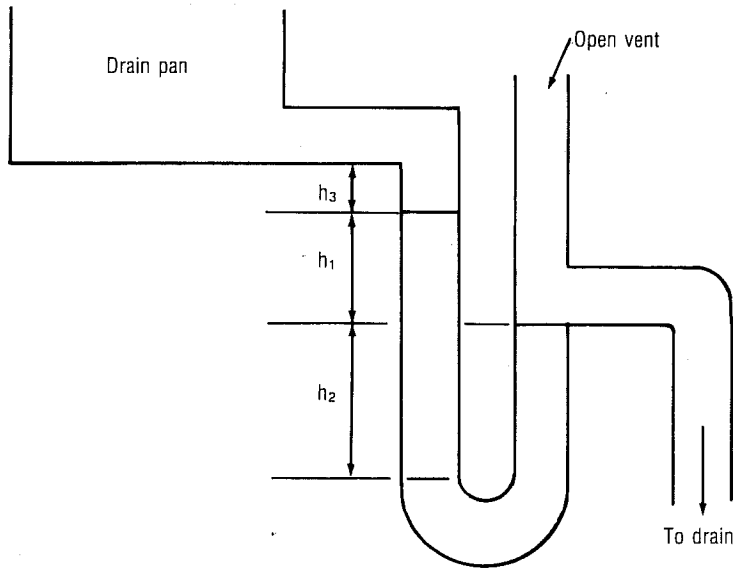


Fig. 8-1. Draw-through unit.

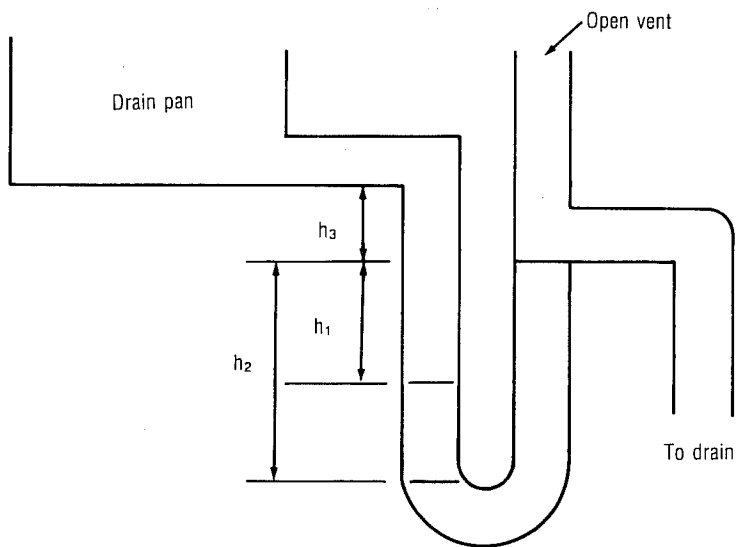


Fig. 8-2. Blow-through unit.

illustrates the proper trap arrangement for this type unit, shown in the operating condition. The trap functions like a simple manometer. It should be designed such that under no conditions is there any accumulation of water in the drain pan. The level of water in the right leg is, of course, established by the

connection point of the outlet pipe. The difference between this level and the operating level of the water in the left leg is equal to the negative static pressure (in. WG) at the fan inlet. Dimension h_3 is simply a margin of safety which the designer establishes, depending upon conditions such as available space

and accuracy of anticipated pressure calculations. The depth of the trap below the outlet (h_2) is critical. Upon unit shutdown, the level in the leg will drop to that at the outlet. Then, upon restarting, it will rise to the midpoint between the outlet level and the operating level. The water to provide this rise comes from the right leg, thus establishing the minimum dimension for h_2 as one-half h_1 . To provide a margin of safety and to allow for evaporation, the recommended minimum dimension for h_2 is that equal to h_1 . The open tee at the top of the right leg is necessary to prevent siphoning of the trap on shutdown, and it also serves as a point for priming the trap.

It is readily seen that such trapping can require considerable vertical space. If the drain pan is operating at 3 in. negative static pressure, the minimum distance between the

bottom of the pan and the bottom of the trap is 6 in. plus the diameter of the pipe—generally not available if not planned for!

A similar logic applies to the trap design for the blow-through unit, wherein the drain pan is at a positive static pressure. This case is shown in Fig. 8-2, illustrating the conditions with the unit running. Dimension h_1 is the operating static pressure on the pan. The depth of the trap (h_2) must then be adequate to provide for this depth plus a margin of safety; the recommended dimension for h_2 is twice h_1 . The distance between the pan outlet and the trap outlet (h_3) is, in this case, not critical if it is held at any value equal to or greater than zero. If, however, it is negative (i.e., the trap outlet is above the pan outlet), the difference in elevation should not exceed one-half h_1 . If this were to happen, some of the operating volume of the trap would be lost on shutdown.