

HVAC Air-TrapTM

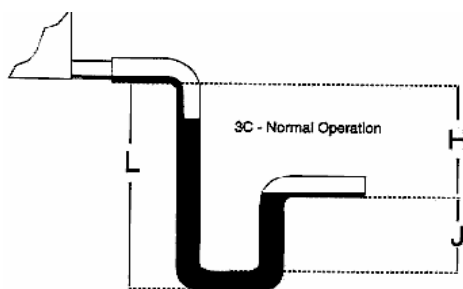
A Waterless Trap from Des Champs Technologies LLC

**ELIMINATES NEED TO CONSTANTLY MONITOR DRAIN TRAPS
FOR DRY-OUT AND FREEZING**

P-trap, the Standard Condensate Trap of the HVAC Industry

When it comes to mouse traps, it is difficult to find a newfangled trap that works better than the standard spring-loaded Victor-type that has been around for over a hundred years. Likewise is the case with the “P” trap or P-trap, the industry standard for removing condensate or water from an air-handling unit (AHU) while simultaneously preventing dilution of conditioned air by outdoor air. The principal reason the P-trap has had such staying power is its first cost and simplicity. In many parts of the world, if properly designed, it does its job okay. However, in areas where freezing weather occurs, there are four distinct seasons, or where hot and dry conditions exist, the P-trap has negative issues. **Figure 1** shows typical P-trap design guidelines.

Figure 1a Negative Plenum Pressure

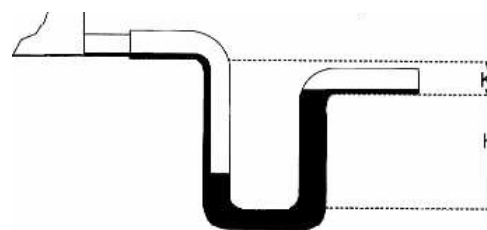


$H = (1'' \text{ for each } 1'' \text{ of maximum negative static pressure}) + 1''$

$J = \text{half of } H$

$L = H + J + \text{Pipe Diameter} + \text{Insulation}$

Figure 1b Positive Plenum Pressure



$K = \text{min. } 1/2''$

$H = 1/2'' \text{ plus maximum total static pressure}$

The most common problem with the standard trap is when there is little or no water in the trap. This occurs when the P-trap never had water fill, operated for extended periods with no water generated within the AHU, or never filled with water even during condensate production because:

- a) For negative pressure, a geyser effect as the condensate attempts to exit through a drain opening having high velocity incoming air, causing insulation, fans, motors, etc. to get wet
- b) For positive pressure, the velocity of the air escaping through a dried out trap is sufficiently high that it carries the water that is condensing with it as the air exits the trap.
- c) Proper design for the height of a standard trap is to have a minimum between the bottom of the trap and the bottom of the horizontal drainpipe exiting the trap of 2 times the maximum pressure in inches of WC expected within the AHU plenum where the drain is located. Because of height restrictions, many trap designs do not meet these dimensional requirements, which could lead to dry out and air by-pass (the greater the depth of a P-Trap the less chance of it drying out).
- d) A syphoning effect caused by washing the drain pan or any surge of water through the P-trap could lead to dry-out and a loss of the air seal.

Second on the list of P-trap problems is freezing and breaking. At the end of the cooling season, water fills the trap to near the horizontal trap exit pipe, leaving more than enough water within the trap to carry over to the freezing season. Unless the trap is heat traced or filled with some form of antifreeze, the trap will freeze and possibly break. Freezing is generally considered to be the number one trap problem because the results are readily apparent and are costly whereas dry out is not readily apparent but can be more costly because of wasted energy. In addition, broken traps caused by freezing, if not immediately repaired, lead to dry out which can persist for years.

The operation of a P-trap, with continuous filling and drying, leads to sludge or debris collecting in the bottom. Without proper trap maintenance, the drain pan could overflow.

The height required for a P-trap is the last issue discussed. In an AHU, the condensate drain pan normally rests on the unit floor. The drain-line connection is at the lowest point of the sloped pan. The AHU floor is on a frame that varies in height from four inches (light commercial) to eight or more inches (commercial). For commercial HVAC equipment, typical pressures within the AHU range from minus 6 inches to plus 6 inches WC. If a unit were to be operating at minus 6 inches WC maximum negative plenum pressure then the trap height, per the guidelines shown in Figure 1a, requires $7 + 3\frac{1}{2} + 1\frac{1}{2} + 1$ inches of height from under the floor or about 13 inches below the floor level. With a unit frame height of 8 inches, a curb is

required under the unit in order to accommodate a properly designed P-trap... an expensive proposition.

The Des Champs Technologies HVAC *Air-Trap*

Des Champs offers a waterless trap designed for negative plenum pressure, N-Series, and one designed for positive plenum pressure applications, the P-Series. The majority of HVAC trap applications are on draw-through AHUs, where the cooling coil is in a negative pressure plenum. Draw through designs generally result in less overall pressure drop through the AHU because of more evenly distributed airflow through the components, such as dampers, filters, coils, and heaters. There are also persuasive reasons for specifying a blow-through AHU.

The Des Champs Waterless N-Series HVAC *Air-Trap*

Figure 2 illustrates the height saving of the N-Series *Air-Trap* when compared to a standard P-trap for a typical installation. The illustration is for a 2-inch negative pressure system but the ratio of 4+ to 2 (P-trap to N-Series *Air-Trap*) holds for any negative pressure, i.e., if the negative pressure is 4 inches WC then the P-trap requires approximately 9 inches of height whereas the N-Series *Air-Trap* requires only 4½ inches of height. This reduced height requirement could result in considerable cost savings during installation.

Shown in **Figure 3** is a cutaway view of the Des Champs N-Series *Air-Trap*. The hollow ball travels on horizontal rails and with the fan on and no condensate flowing, the ball valve snugs against the left circular entrance port/seat, resulting in essentially no air drawn through the trap and into the AHU. Once condensate flows, the ball stays against the seat until the water level in the vertical standpipe reaches a height H, in inches, equal to the plenum negative pressure in inches WC. When the water column reaches height H, the water pressure on the ball equals the negative air pressure holding the ball against the seat and the ball moves away from the seat, allowing water to flow. When condensate ceases to form, then the ball valve returns to the seat and prevents air from flowing into the unit.

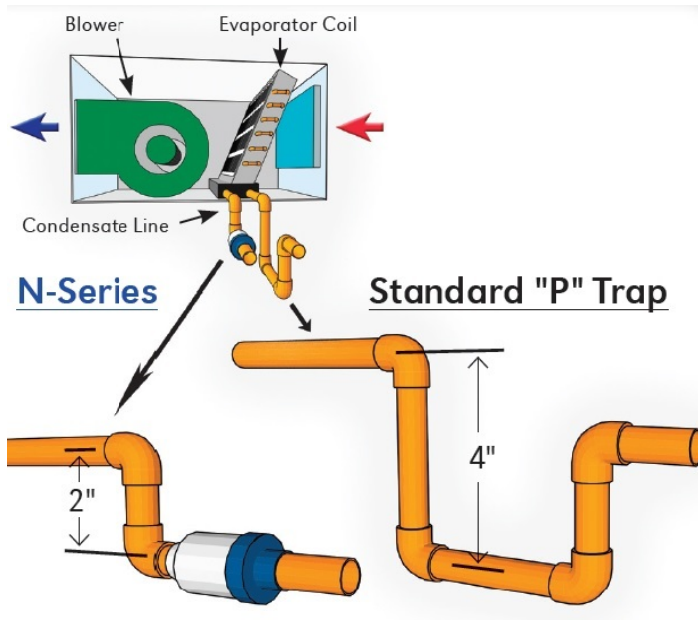


Figure 2 Comparison of standard P-trap and Des Champs N-Series **Air-Trap** installed in a draw-through, horizontal position

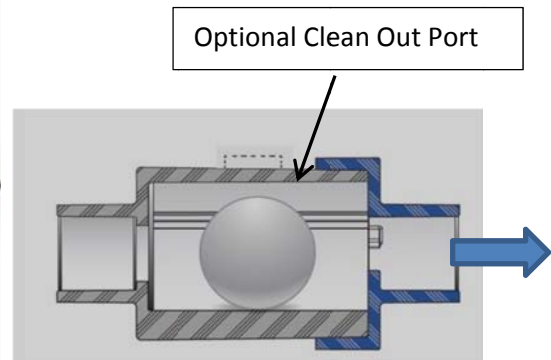


Figure 3 Des Champs N-Series **Air-Trap**

HVAC AHU

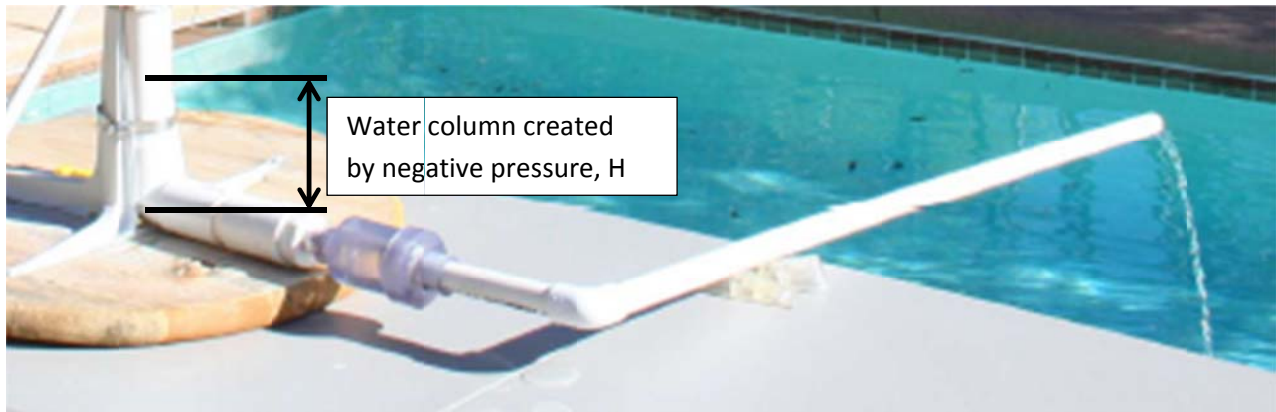


Figure 4 Des Champs N-Series **Air-Trap** undergoing tests at the Des Champs Technologies Las Vegas, NV test facility. Testing videos showing the operation of the trap are viewable at www.deschampstechnologies.com, then go to **N-Series** and then to **N-Series YouTube Presentation**

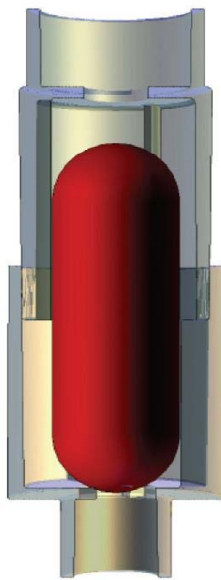
The seal is not 100% airtight. The air leakage is less than 0.1% of what would leak through the drainpipe for an equivalent P-trap when operating dry. This slight amount of air leakage is assurance that no water will remain in the trap or incoming standpipe when freeze time comes. The N-Series **Air-Trap** operates at essentially any negative pressure up to the distance, in

inches, between top of the water level in the plenum and the centerline of the horizontal N-Series **Air-Trap**. Maximum water flow rate is greater than two GPM, which is equivalent to over 80 tons of latent cooling.

The N-Series **Air-Trap** has sufficient merits for consideration on all negative pressure plenums. However, there are many instances when it is essential to consider their use. For instance, a contractor informed an AHU manufacturer that a back charge of \$50,000 is eminent because late delivery results in having to remove building walls and putting units on curbs, not included in original specification. The reduced height of the N-Series **Air-Trap** removed the requirement for curbs and eliminated the back charge.

The Des Champs P-Series HVAC **Air-Trap**

Shown in **Figure 5** is a cutaway view of the Des Champs P-Series **Air-Trap**, used for



removing condensate from plenums operating under positive pressure. Whereas the N-Series **Air-Trap** must be installed and operate in a horizontal position, the P-Series **Air-Trap**, because its operation depends upon buoyancy to properly function, must be operated vertically. With no production of condensate within the AHU the positive pressure that exists within the plenum, containing the drain line, forces the capsule (or spherocylinder), shown in red, downward onto the valve seat. With the production of water within the plenum, the capsule rises from the seat when the net buoyancy force upward equals or exceeds the net downward force created by air pressure.

Figure 5 Positive Pressure Des Champs P-Series **Air-Trap**

The P-Series **Air-Trap**, in addition to installing vertically, has other factors that are important to understand and consider during its design into the drainage system. These factors relate to the fact that the capsule rises and falls depending upon the pressure differential between the pipe pressure entering the trap at the top and the pipe pressure leaving the trap plus the buoyancy of the capsule when water is present. The air pressure at the top is equal to the plenum pressure, and at the bottom, it is normally ambient pressure.

However, if the piping system leaving the trap is long, has sags, or is too small in diameter to accommodate the water flow, then a syphoning effect could develop at the bottom of the trap, creating a negative pressure sucking the capsule downward. This, in turn, could cause the trap to malfunction. To prevent a negative syphoning pressure, install a vent pipe directly below the exit of the trap as shown in **Figure 6**.



Figure 6. Positive Pressure P-Series HVAC **Air-Trap** undergoing tests at the Des Champs Technologies Las Vegas, NV test facility. Testing videos showing the operation of the trap are viewable at www.deschampstechnologies.com, then go to P-Series and click on the link **P-Series YouTube Presentation**

The P-Series **Air-Trap** is a waterless trap used to drain water from HVAC plenums that are operating at a positive pressure created by a blow-through fan arrangement within the AHU design. There are many reasons to design an AHU for a blow through arrangement and a few are:

- a) As an aid in preventing outside air from entering the AHU
- b) To reduce the noise level within the supply air plenum
- c) To accommodate a more compact design
- d) Cool fan and motor heat prior to air delivery to conditioned space

- e) For energy recovery units, to prevent exhaust air leakage into supply airstream

An example for application of the P-Series **Air-Trap** is for AHUs used to remove heat from data centers. This type of AHU could incorporate both an indirect evaporative cooler and a complementary cooling coil. Both cooling components can produce condensate, so there are typically trap requirements in three or four separate plenum compartments, including the blow-through fan compartment. Blow through is desirable to keep the unit under positive pressure to prevent leakage of outdoor air into the highly filtered and humidity controlled recirculating air and to enable the cooling system to remove most of the heat generated by fans, motors, and compressors before delivering the cooled air to space. There is also less noise in the supply duct.

Recirculating cooling air typically returns to the AHU at around 95°F and cools to 75°F. Seldom, under these conditions, does condensing occur. Consequently, the standard P-traps require frequent filling, a costly maintenance issue considering there could be upwards of fifty traps to fill. If they go dry, the pressurized recirculating air leaks to outside of the conditioned space, resulting in the facility's make-up air system becoming inadequate. Freezing could also be an issue with P-traps.

Data center owners complained about the maintenance issues associated with using standard P-traps on their AHU cooling units. Specifying engineers responded by specifying the Des Champs P-Series **Air-Trap**, a waterless trap. It does not require water to prevent airflow out of the AHU and consequently eliminates the need for routinely filling the traps with water. In addition, during the cold months, when the cooling coil is not condensing, the **Air-Trap** is dry. If, for some reason, water is flowing from the unit during freezing temperatures, and the trap is located within this freezing temperature region, then the trap will require thermal protection.

Summary

The Des Champs **Air-Trap** designs are patented and unique. They have tremendous benefits if properly installed per the manufacturer's instructions, which are simple and straightforward. They are:

- 1) For N-Series, install horizontally with water flow in direction of arrow with arrow on the top of the trap after installation.'
- 2) For P-Series, install vertically with end marked TOP on top. If a long length of drain pipe and/or a small drain pipe, less than 1¼-inch diameter, then a vertical vent tube is required to be installed as near to the exit of the trap as possible.