

SteamTeam®

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Specifying Tips: Vacuum Return Condensate Units

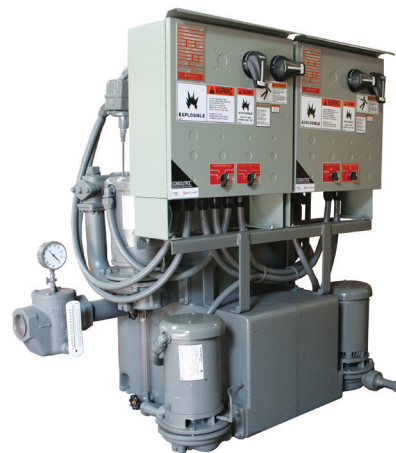
Should you replace your vacuum return condensate system with a standard condensate return unit?

Before you decide, let's look at what happens when a steam heating system starts up—a cycle that can happen many times a day, depending on the weather.

At startup on a two-pipe steam system, the steam mains, radiators and dry return lines are drained, and the entire system above the boiler's water line contains air. Any steam added to the heating zone must push that air out of the mains and radiators, via air vent valves or thermostatic traps on each radiator and at the end of the steam main. Heating begins as steam replaces the vented air. Usually the radiator nearest to where the steam enters the building heats first. As air is vented along the steam main, additional radiators receive steam. Depending on steam main length and vent size, it may take five to 20 minutes for the system to vent and distribute heat throughout the building.

Attempts to improve the balance of heating in large single-zone heating systems included orifices to reduce steam flowing to radiators at the steam main's supply end. In one-pipe systems, adjustable air vent valves were installed on steam radiators. While these methods helped, they could not adjust to different degree days, and the heating balance still suffered.

Vacuum systems overcome these difficulties, using a vacuum pump on the end of the return line to remove air from the system and maintain a 3" to 8" Hg vacuum. When the system is cold, the thermostatic traps are open, and air is removed from the radiators and supply lines. Removing air increases the differential between the positive pressure in the boiler and the sub-atmospheric pressure in the rest of the system. Steam flow is several times faster than in standard atmospheric systems, improving heat balance and speeding startup.



Vacuum Return Condensate Unit

Other advantages include faster condensate return. That reduces surges caused by condensate holdup—which can cause frequent low-water cutoff at the boiler, and boiler flooding when large slugs of condensate suddenly return. Increased differential pressures across the system let designers reduce return pipe sizes, reducing upfront costs. The system can also use lift fittings and drain low wetted return lines without an additional condensate return pump in a pit.

When today's building operators consider replacing vacuum pumps with standard vented condensate units, the engineer/contractor should point out these vacuum system advantages. If the system is removed, occupants on one side of the building may start opening windows due to excessive heat, while other occupants complain about being cold. Noisy returns may become an issue, because the smaller pipes of a vacuum system do not allow adequate condensate return on a vented system. Resulting holdup may lead to condensate surges that overwhelm the vented unit, dumping treated condensate down the drain instead of recovering it.

Increasing steam pressure or installing individual thermostatic radiator valves usually doesn't work. The only way to eliminate the vacuum unit and maintain proper balance is to rezone the steam distribution lines. This requires additional thermostats, zone control valves and perhaps even a complete re-piping—often impractical and seldom cost-effective.

That leaves you to maintain the vacuum system. Piping must be tight. Thermostatic traps must be maintained to control returning condensate temperature—160°F for peak efficiency, with a maximum of 180°F, since the system is under a vacuum and flash temperature of the boiler water is reduced. Higher temperatures or flash steam can cause cavitation in the pumps, shorten seal life and damage other components, resulting in expensive repairs. Proper trap maintenance is key to system balance and vacuum pump life expectancy.

Two types of vacuum units are typically seen on vacuum heating systems. The *combination vacuum condensate pump* creates the vacuum and provides the pumping pressure to return condensate to the boiler or to the feed unit, using the same pump for both functions. Other units use *separate air removal and condensate pumps*, which allow for individual sizing of air removal capacity and water transfer capacity (often needed in older systems to handle increased air leakage). The separate air pump also lets you use a temperature limit switch in the return line or the condensate tank to cut out the vacuum pumps when poor trap maintenance

causes excessive condensate return temperatures. Some separate air removal and condensate pump systems can allow for this as the vacuum is not critical when the system is up to operating temperature.

Vacuum boiler feed systems are also useful for boiler conversions. New boilers often have considerably less water storage capacity; you need to install a boiler feed unit with a tank that can store condensate. With the vacuum pump installed on the feed unit, the condensate returns under vacuum directly to the feed tank. It is stored under vacuum until required by the boiler water level control.

Finally, note that eliminating your system's vacuum return pumps will likely increase operating and fuel costs. A system designed for vacuum service includes pipes sized and located for vacuum service. In the end, it may simply be more practical to properly maintain the existing system and continue to operate under vacuum.

Jarek Berezowski
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When a bucket trap is the wrong choice

Although inverted bucket traps have a long history in the steam business and can stand up to demanding application, they're not always the best choice—especially in a system with fluctuating loads.

Steam traps of any design must be able to perform these three functions:

1. Vent air from system so steam can enter.
2. Hold steam until its latent heat is removed.
3. Remove all condensate that forms when steam condensates.

Inverter bucket traps are good for steps 2 and 3, but they don't vent air from a system quickly. That's a problem with a changing load—for example, in a heating system where outside temperatures cause frequent cycling. When the system turns on, the load is heavy. As pipes and radiators warm up, the load is reduced. Every time the system turns off, steam

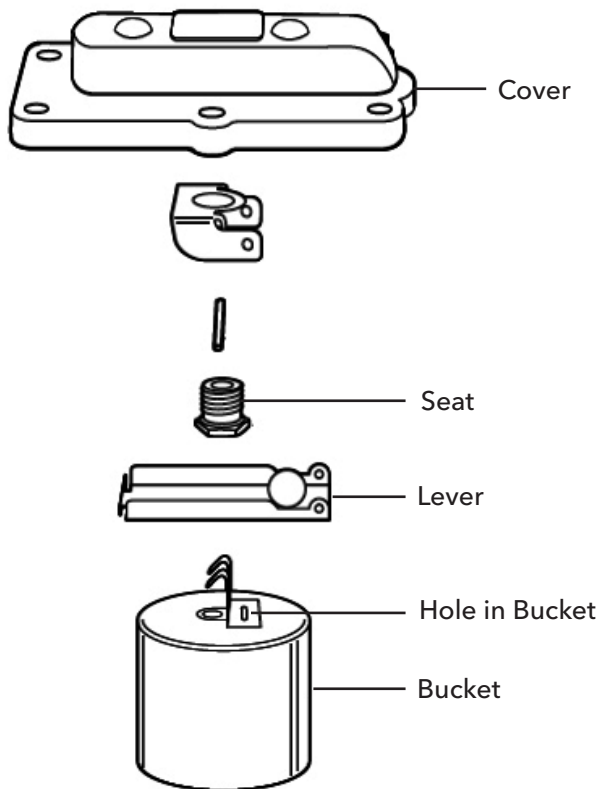


Inverted Bucket Trap

condensate air rushes back to fill the vacuum. This air must be removed before steam can enter the system for the next cycle. Bucket traps just aren't quick enough to handle this ongoing steam and condensate fluctuation.

Loads modulated by steam heat exchangers and air makeup coils with modulating control valves also work against the bucket trap. The control valve responds to load changes by changing system pressure, which affects the pressure differential across the trap. That changing pressure differential reduces the bucket trap's capacity.

Remember, the bucket inside the trap is actually upside-down (hence, “inverted” bucket trap). This bucket has a specific weight for open/close operation. It is attached to the cover by a lever. At the other end of the lever is a plug, which is driven into seat of the trap when it closes. The trap is normally open, with the plug pulled down by the bucket’s weight. When steam starts flowing, it goes through a hole in the bucket. As more steam flows, the bucket becomes buoyant and the trap closes. Steam eventually condenses, the bucket loses its buoyance, and it falls, opening the seat. Condensate can drain through the seat to return piping.



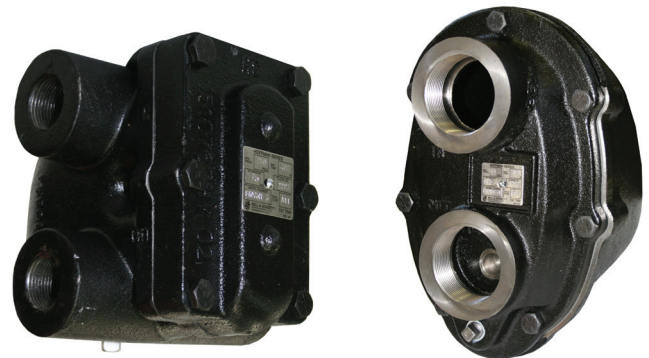
To work correctly, bucket traps need to be primed with condensate. If the trap loses its prime, typically due to a low load, steam may bypass the bucket and

flow directly into the return. The steam entering the trap will actually re-evaporate condensate inside the trap. Without any condensate in the trap, steam can easily pass through trap into the return line.

So what type of trap should be used in a modulating loads application?

A Float & Thermostatic (F&T) trap is the best choice for applications with modulating load. As the name implies this trap contains float and thermostatic element. The thermostatic element is designed to vent large amount of air, and float can handle modulating load of condensate. These two conditions occur in every heating system and in every system with modulating steam load.

Hoffman Specialty offers many models of F&T traps:



Series H Trap

Series C and X Traps

For more information on steam traps, contact your local Hoffman Specialty representative. Use this link to find a representative in your area: <http://bellgossett.com/representatives/>

You can also visit our website at <http://bellgossett.com/steam-specialties/>

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- 1) The tissue in plants that brings water upward from the roots;
- 2) a leading global water technology company.

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For more information on how Xylem can help you, go to www.xyleminc.com



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