xylem
Let's Solve Water

SteamTeam®

Bell & Gossett®
McDonnell & Miller®

VOLUME 6 / ISSUE 3/OCTOBER 2019

Jarek Berezowski
Assistant Product Line Manager-Steam Products,
McDonnell & Miller

When a Steam Trap failed open

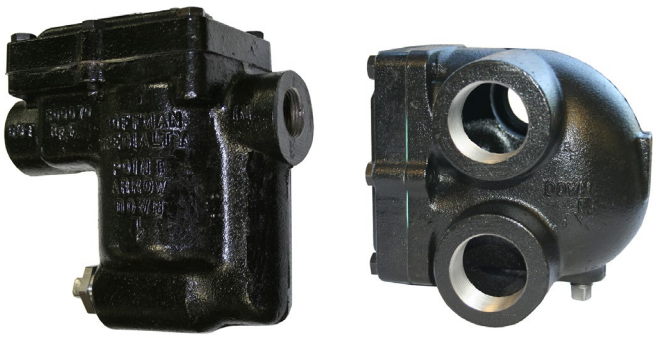
When a steam trap failed open, and allows live steam to pass by, it is easy, and convenient to ignore symptoms or place on our never-ending list of "things to do." After all, what harm is it besides wasting little energy that cost a few bucks? The boiler is still running, building is heated, tenants are not complaining, and everything seems to be fine. However, a failed trap will cost you more than just the loss of a small amount of steam. It will cost you a lot more.

The Cost of Lost Steam

Let's examine how a trap passing steam can affect the whole steam system. First, you need to determine how much the loss of steam really costs. Since the steam is being lost at saturation condition (0 psig from the vented tank receiver) we can determine amount of energy (Btus) that will not be recovered. 0 psig steam contains 970 Btu/lb. So, for every pound of steam we don't recover, we lose 970 Btu's. But we're losing more than just that latent energy. This is only a part of energy wasting. We are also losing sensible energy. Having lost that pound of steam, we must now replace it with a pound of water and we have to add energy to the new water just to bring it up to saturation condition (for water it is approximately 1Btu/lb°F). Let's say the water we are introducing is 60°F. Because we lost our steam through a vented receiver, we have to raise its temperature to 212°F. And because the steam we lost had already been treated, there is the additional cost of treating the new water. Now let's see how much it can cost you.

Single trap with 3/8" orifice discharging 100 psig of steam to atmosphere will cause a steam loss of 652 lb. /hr. Since each lb. of steam is equivalent to about 1,000 BTU/hr. Loss will be 652,000 BTU/hr.

On gas fired boiler, operating at 70% efficiency will produce about 70,000 BTU for each Therm of Natural Gas. The gas required to replace the lost of steam will then become 652,000 BTU/hr.÷70,000 BTU/Therm. or 9.31 Therms per hour.



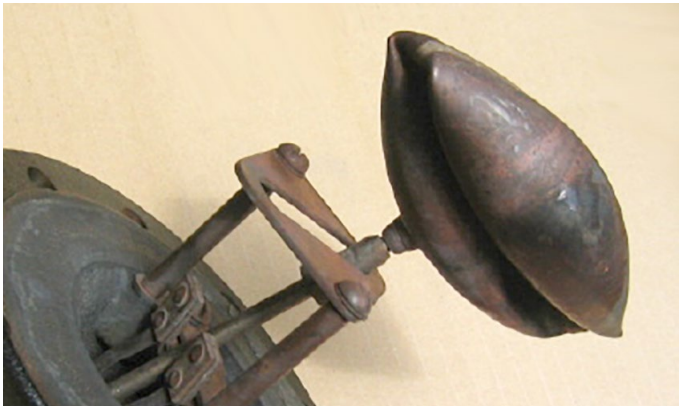
Hoffman B Series inverted Bucket Trap and H Series Float & Thermostatic Trap

If Natural Gas cost $1.27/therm. (US average June 2018 bls.gov) the money wasted due to the faulty trap becomes $11.82/hr. (9.31 * 1.27). If the boiler is operating 241 days/year. October 1st – May 1st 10 hours/day it becomes $28,486/year.

The significance of these savings becomes rapidly higher when you consider that an even small steam system usually has several traps, and larger system can have more than 1,000 traps.

Other Effects of failed Traps

Having this information we are able to calculate the energy loss associated with losing steam through a bad trap. However, there are other indirect costs related to the failed trap that are more difficult to calculate. One is the damage caused by water hammer. As steam enters a condensate return line, there is the chance steam will mix with the condensate and some of the condensate may flash into steam and collapse into condensate, causing water hammer…remember this banging pipes? Water hammer can cause serious damage to steam system. One failed open steam trap may destroy the rest of the traps, (Remember when you are replacing a thermostatic element it is extremely important to replace all before restarting the system).



McDonnell & Miller float destroyed by water hammer

A failed trap can pressurize the return main resulting in insufficient differential pressure across other traps draining into the same main as the failed trap. Consequently, condensate will back up in the processes the traps are associated with. Someone will wrongly diagnose these traps as being defective, possibly even replacing a good trap and still not getting the desired results. Frustrating! Because the trap has no differential pressure due to the pressurized condensate line, there is also the possibility of water hammer occurring in the heat transfer device that cannot drain. Again, the mixing of steam and condensate can cause water hammer.

Higher Steam Temperatures Problems

This is not the last of the problems that a trap passing steam can cause. With steam passing through the trap, the return condensate is at a higher temperature, which sounds like we are saving energy by not having to add as much sensible heat to the condensate to bring it back up to saturation conditions. But the warmer the condensate is, the more flash steam. Even worse, the pumps will handle hotter condensate, and this can have a negative effect on the pump seals (Viton seal will only help in the short run). And, the higher the temperature, the less NPSH (Net Positive Suction Head) we will have available at our pump suction. Less NPSH available, increases the chance for cavitation to occur in our pump.

Impeller destroyed by cavitation

So, the indirect cost of a trap passing steam may be great. The best solution is to understand the operation of your traps, survey and test them on a regular basis, and repair or replace the traps when they fail. The cost will always be justifiable.

The next time you have problems, look at the whole system. Remember that even if the process is still working, a bad trap may actually cause other, more serious problems.

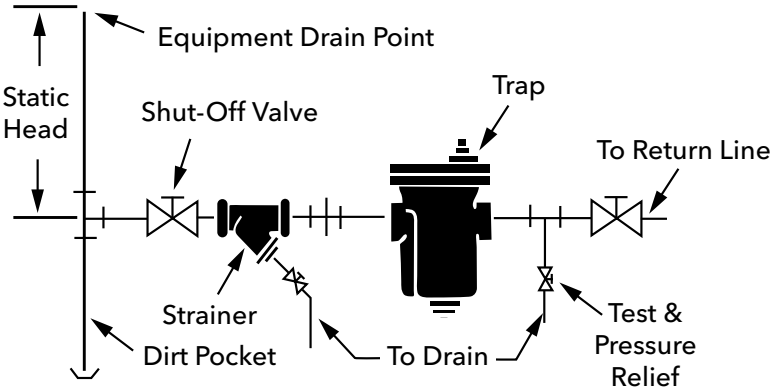
To determine if the trap failed open may require some special tools and some experience.

1. Start your work with a plan. (It is always a good idea to have plan).
2. Use tags to identify traps
3. Form to record trap data

You will need to have test equipment. Thermometer (You can use an Infrared Thermometer), stethoscope or ultra-sound. Now you can start your traps testing.

Make sure the steam system is on. Use a thermometer to measure the inlet and outlet temperature. If the trap failed open the temperature reading will be the same. Use a stethoscope or ultra-sound device to listen for steam blowing through trap. If a trap failed open it will have a low pitch whistle. A steam trap working correctly will have a wet gurgling sound.

Below you can see typical trap installation. If your installation is equipped with a Test and Pressure Relief Valve you can use it to determine what passing traps steam or condensate.



For help with any steam problems, contact your local Bell & Gossett sales representative. They have the answers to all of your questions.

http://bellgossett.com/sales-service/

Bozhidar "Boz" Ivanov
Sr. Product Specialist, Domestic Pump

How to manage a broader range of pressure?

The well-known Domestic Pumps from Xylem can handle up to 212°F of boiling condensate, without cavitating, without vapor locking and in many cases even without elevating the tank. Units will do their job and transfer the condensate back to the boiler room, or to the boiler itself. The condensate will travel through pipes, fittings, ups and downs, before reaching its final destination. If it is a boiler feed pump then overcoming the operating pressure of the boiler should be accounted for, too. All the pipes and fittings along the way will try to give our pump a hard time because of the pressure drop along them.

To calculate this pressure drop you have to take into account how far you're going, and how high you're going. Sounds simple but it may not be. How far includes not only the distance but also the equivalent distance for each fitting, each valve, each elbow, and the losses for all the piping. How high refers to elevation, but elevation can be both positive and negative. This means careful review of plans, or specifications that have already taken all of this into account and determined what the total losses to the pump are in the discharge piping before the pump delivers its condensate to where it needs to be.

For low pressure boilers less than or equal to 50 psi the discharge pump pressure needs to be greater than the losses by a minimum of 5 psi. If losses are 10, we take 15. For systems where boiler pressures are greater than 50 psi, your discharge pump pressure needs to be greater than the losses by a minimum of 10 psi, in order to be on the safe side. If we run the unit under vacuum then another 5 psi should be added on top of the above rule, since the pump will be pumping out of an average of negative 5 psi. Sizing the pump is vital for proper operation.

Domestic Pump has standard solutions to overcome up to 100 psi of back pressure and this is more than enough for most steam heating applications.

But what happens when the pressure drop along the discharge piping is higher than 100 psi? Such applications can be found in industrial facilities or in larger steam heating systems with longer and more complex return piping. The solution to that is coming from our large Xylem family, and it is the Gould's e-SV stainless steel multi-stage pumps. Utilizing the e-SV multi-stage delivers a great solution for high pressure condensate and boiler feed units with an efficient and easy-to-maintain multi-stage pump.

Custom condensate return unit, model CED-e-SV

Here are just a few benefits from the synergy between Domestic Pump and e-SV:

- Pumps up to 500 psi discharge pressure
- Stainless steel multistage pumps
- Flexible pump solutions

Most importantly we make sure that the selected e-SV pump models will also transfer boiling water without cavitating and without the need to oversize them. This is achieved by selecting those models that meet the same required net positive suction head (NPSH) like the ones of the Domestic Pumps. All of our units are vented to the atmosphere. This means that the max. temperature of the condensate is 212°F and it is a matter of atmospheric pressure and available water column at pump inlet to provide the required NPSH at pump inlet. We have taken care of that and the design of the units, including tank elevation and types of pumps, will meet the application requirements. Like with Domestic Pump, the e-SV models also have a low-NPSH version to transfer condensate with temperatures at the higher end.

Cutaway of a multistage pump liquid end

In addition to the standard pump options, like discharge pressure gauge, 60 or 50Hz applications, and motor enclosures, we can also add different pump discharge connection styles and different materials for the volute and seals.

Currently there is a number of standardized CMED-e-SV boiler feed models available. Customized units are always available for both Condensate Return and Boiler Feed Units utilizing a range of cylindrical and/or elevated receivers.

Please feel free to reach out with your custom unit inquiry and questions.

Check out our products on www.domesticpump.com

Bozhidar 'Boz' Ivanov
Sr. Product Specialist, Domestic Pump
bozhidar.ivanov@xyleminc.com

xylem
Let's Solve Water

Xylem Inc.
8200 N. Austin Avenue
Morton Grove, Illinois 60053
Phone: (847) 966-3700
Fax: (847) 965-8379
www.xylem.com/bellgossett