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Steam Traps

State Energy Assessment Workshop

By:

DTE Energy Partnership & Services

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Steam Trap Basics

Steam Trap Basics

- Essential Part of any steam system.
- The function of a steam trap is to discharge condensate while not permitting the escape of live steam.
- Most important link in the condensate loop, because it connects steam usage with condensate return.
- Steam trap is also responsible for the purging of air, or any other incondensable gas from the system.

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Why Steam Traps ?

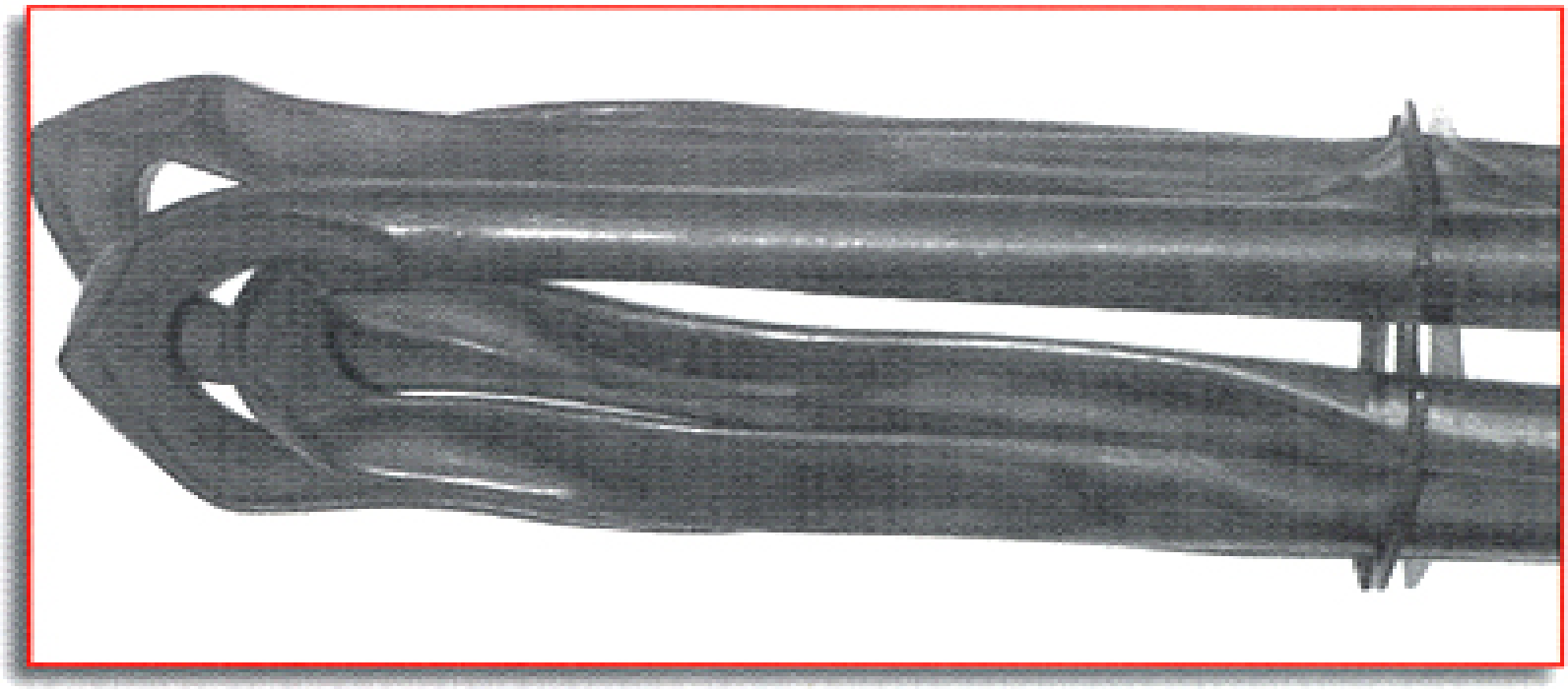
Why Steam Traps ?

- Condensate removal, from steam systems is an extremely important process.
- Backed up condensate reduces the effective potential for heat transfer.
- Excess condensate can cause a serious problem called "water hammer"
- "Water hammer" occurs when slugs of liquid become trapped between steam packets and accelerate to a high velocity.
- When accelerated, the slugs of water can create a "hammer" like effect on various equipment causing extreme damage.

Why Steam Traps ?

- When condensate gets into the steam system it is extremely destructive.
- It can cause valves to wiredrawn and unable to hold temperatures as required.
- Little beads of water in the steam line can eventually cut any small orifices the steam normally passes through.
- Eventually enough of the metal in the valve seat will be cut away preventing adequate closure, which will in turn produce leakage in the system.

Why Steam Traps ?



Picture of Tubes Damaged by Water Hammer

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Types of Steam Traps

Thermostatic Steam Traps

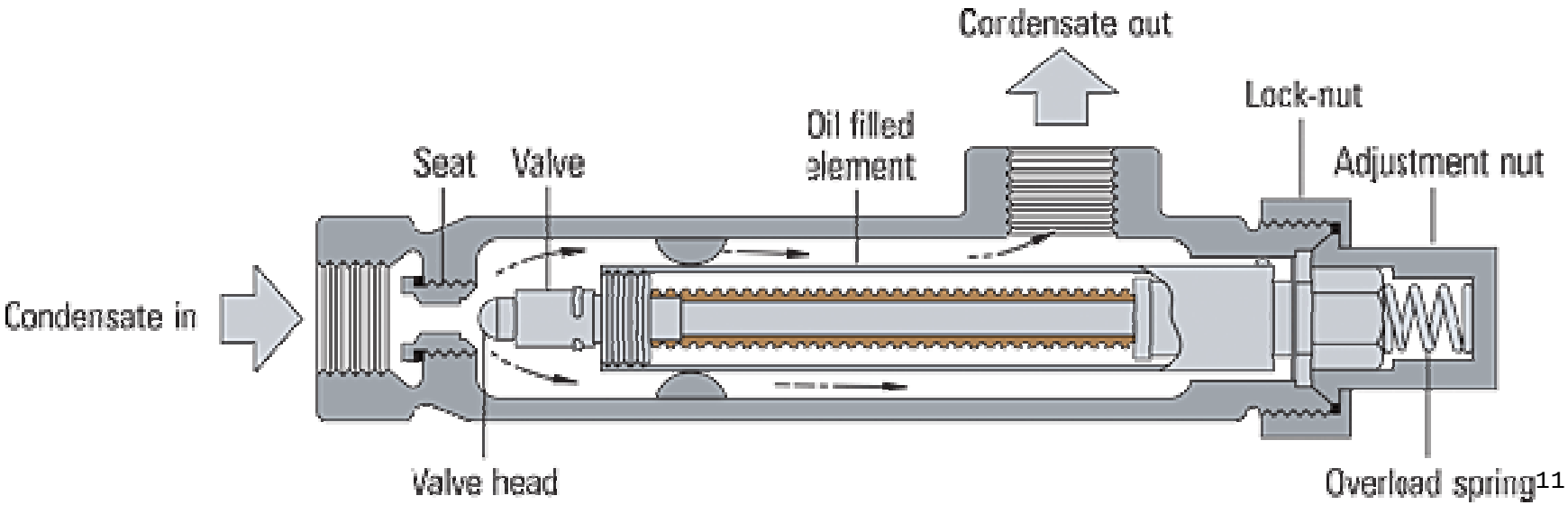
Thermostatic Steam Traps

- Thermostatic steam traps operate by changes in fluid temperature.
- Temperature of saturated steam is determined by pressure. In the steam space, steam gives up its enthalpy of evaporation, producing condensate at steam temperature.
- As a result of any further heat loss, the temperature of the condensate will fall.
- A thermostatic steam trap will pass condensate when this lower temperature is sensed.
- As the steam reaches the trap, the temperature increases and the trap closes.

Thermostatic Steam Traps

Liquid expansion steam trap

- Most simple steam trap
- An oil filed element expands when heated to close the valve against the seat.
- Allows the temperature of the trap discharge to be altered between 60-100 F



Thermodynamic/Disk Steam Traps

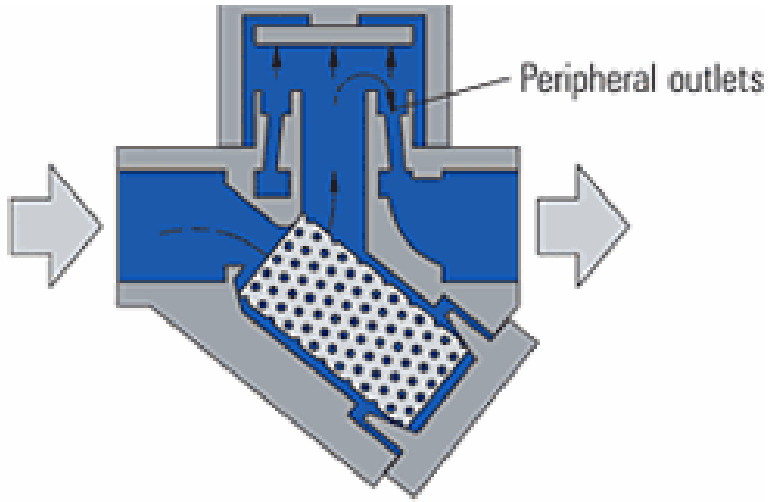
Thermodynamic Steam Traps

- Thermodynamic steam traps are operated by changes in fluid dynamics.
- They rely on the formation of flash steam from condensate.
- Include “thermodynamic”, “disc”, “impulse"," labyrinth”, and “fixed orifice” steam traps.

Thermodynamic Steam Traps

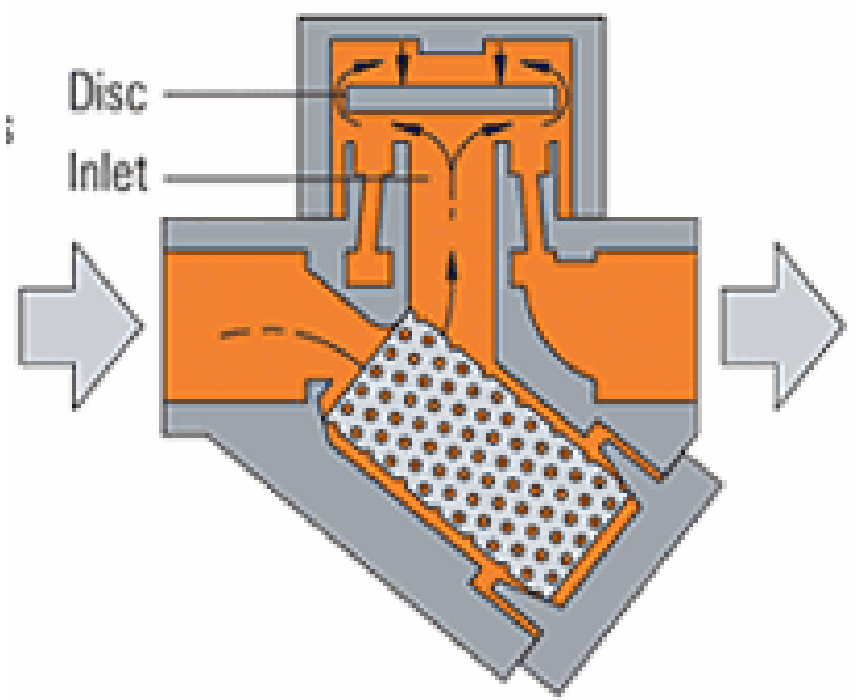
Thermodynamic Steam Trap

- Trap operates by the dynamic effect of flash steam as it passes through the trap, with the only moving part being a flat disk located inside the chamber.
- Upon start-up incoming pressure raises the disk, and cool condensate plus air is discharged from the inner ring, under the disk, and out through the peripheral outlets.



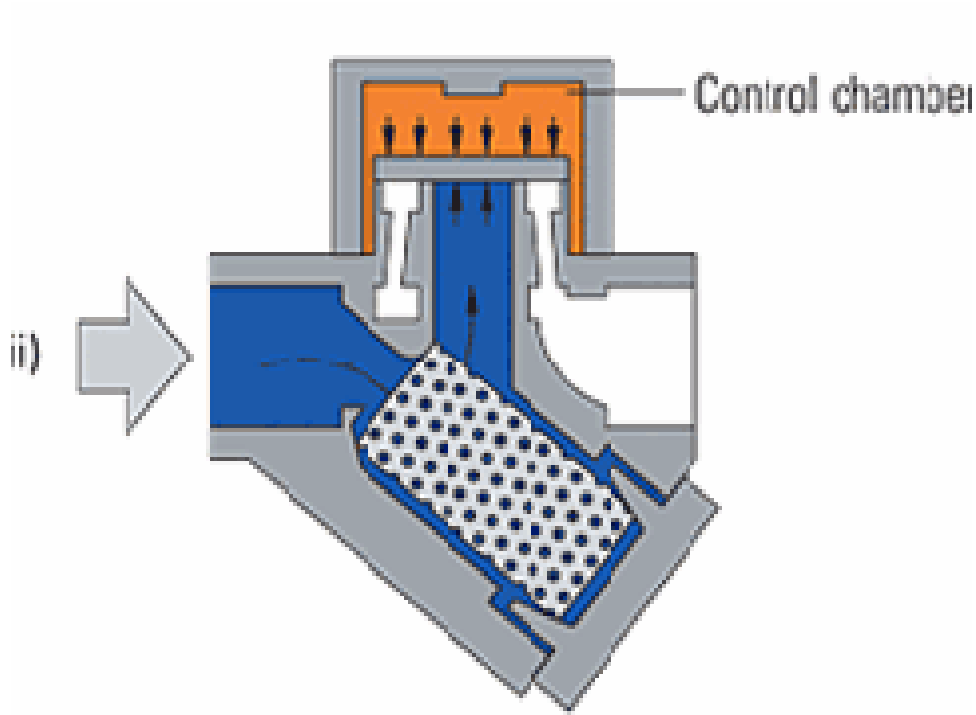
Thermodynamic Steam Traps

- Hot condensate flowing through the inlet passage into the chamber under the disk, drops in pressure and releases flash steam which is moving at a high velocity. The high velocity creates a low pressure area under the disk, drawing it towards the seat.



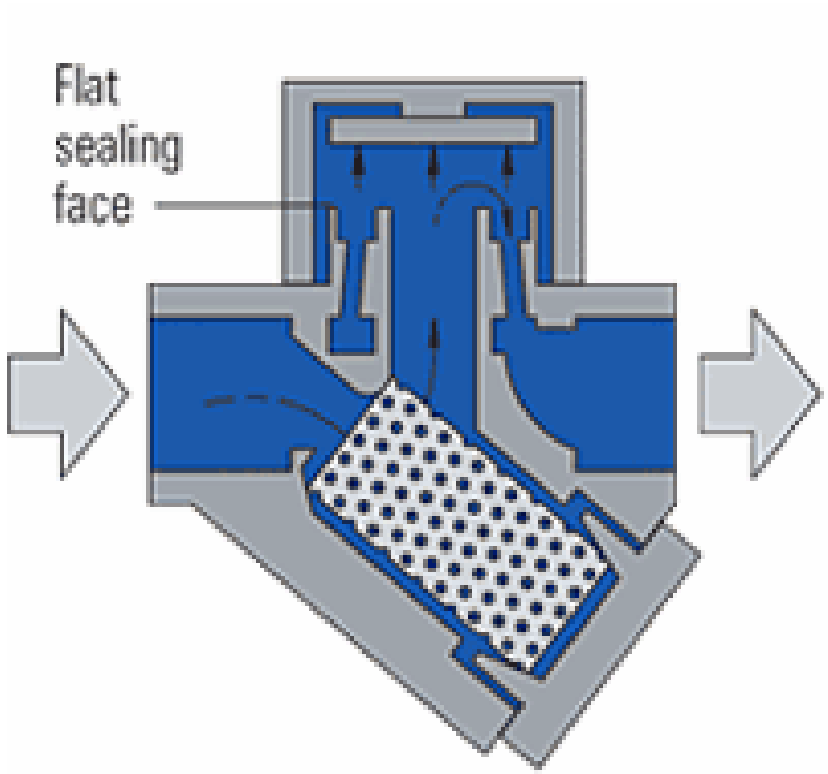
Thermodynamic Steam Traps

- At the same time flash steam pressure builds inside the chamber above the disc, forcing it down against the incoming condensate. The flash steam is now trapped in the upper chamber.



Thermodynamic Steam Traps

- Eventually the trapped pressure in the upper chamber falls as the flash steam condenses. The disc is raised by the now higher condensate pressure and the cycle repeats.



Mechanical Steam Traps

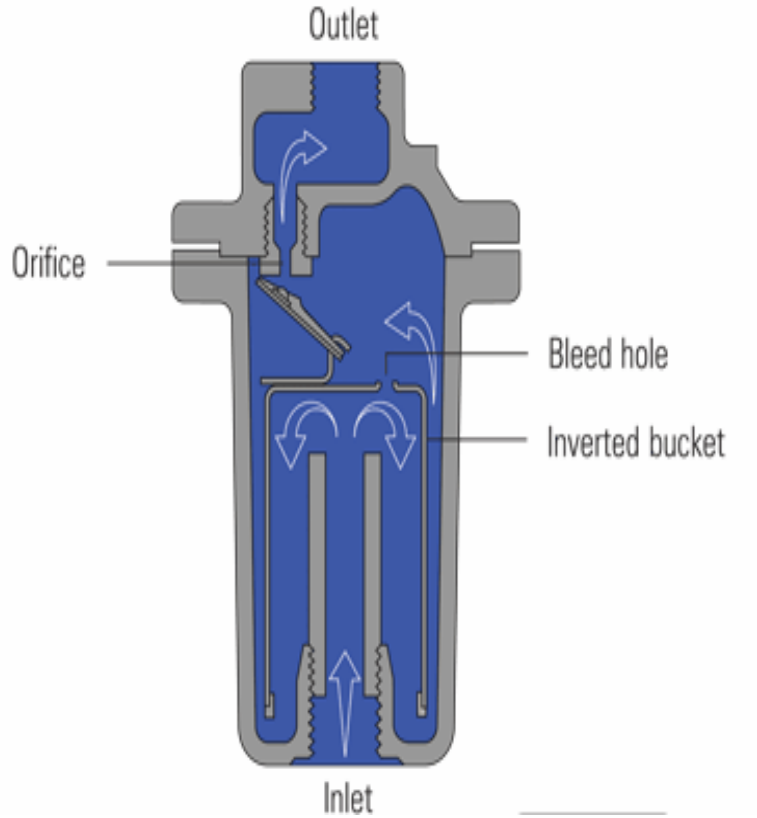
Mechanical Steam Traps

- Operated by changes in fluid density.
- The trap senses the difference in fluid density between the steam and condensate.
- Include “ball float” and “inverted bucket” traps.

Mechanical Steam Traps

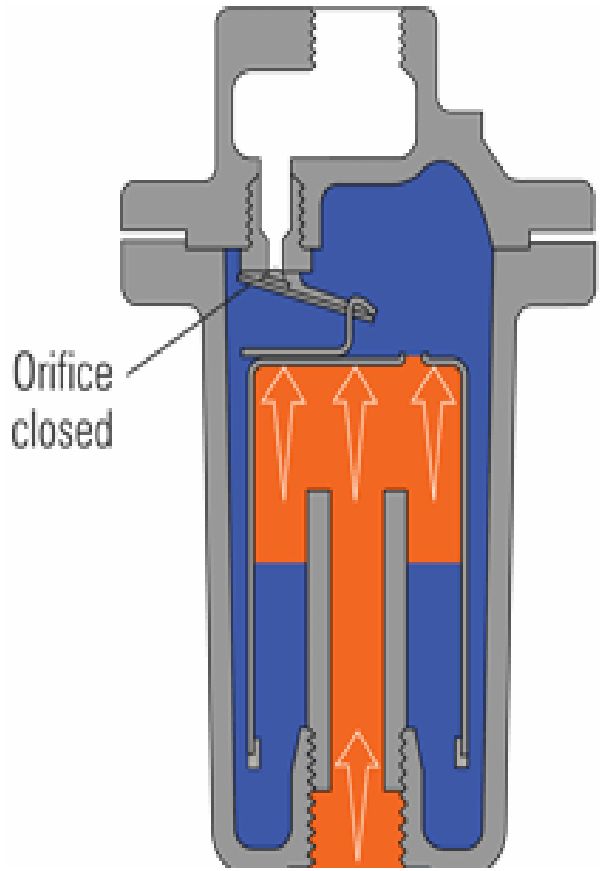
Inverted bucket steam trap

- Mechanism consists of an inverted bucket which is attached by a lever to a valve.
- Bucket hangs down, pulling the valve off its seat. Condensate flows under the bottom of the bucket filling the body and flowing away through the outlet.



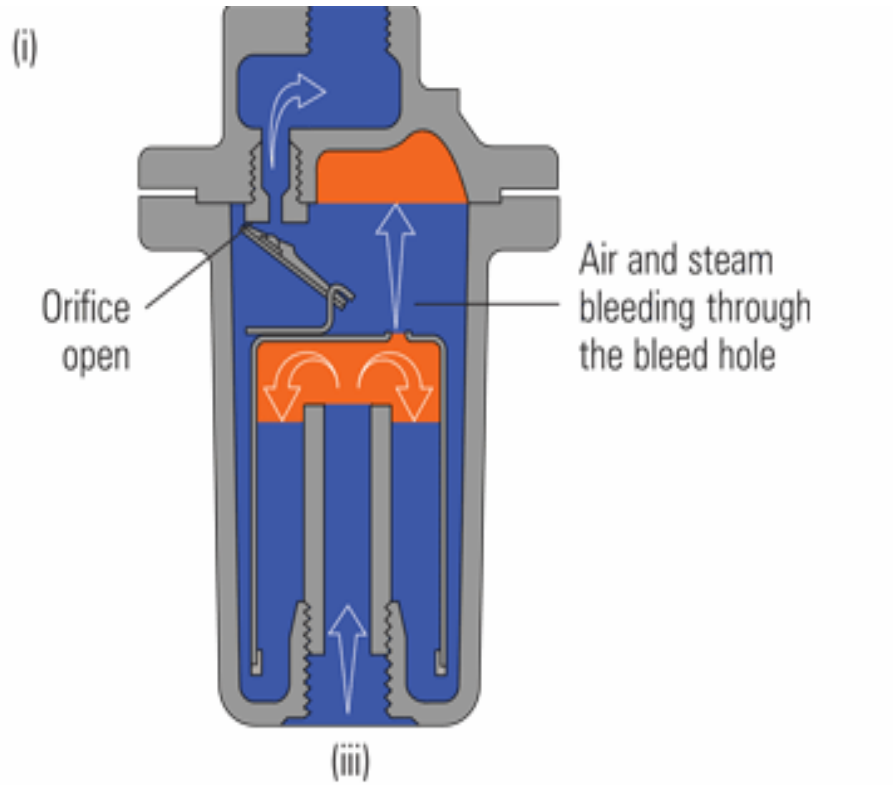
Mechanical Steam Traps

- The arrival of steam causes the bucket to become buoyant, and it then rises and shuts the outlet.



Mechanical Steam Traps

- The trap remains shut until the steam in the bucket has condensed or bubbled through the vent hole to the top of the trap.
- It will then sink, pulling the main valve off its seat. Accumulated condensate is released, and the cycle repeats.



Failed Steam Traps $$ Loss/Month

Pressure at Trap	2 psig	5 psig	10 psig	15 psig	25 psig
Pipe Size of Trap	Dollars lost per month when steam cost is $6.00 per 1,000 pounds				
1/2" radiator trap	$22	$32	$40	$48	$65
3/4" radiator trap	$34	$50	$63	$76	$101
1" radiator trap	$48	$72	$91	$109	$145

Pressure at Trap	2 psig	5 psig	10 psig	15 psig	25 psig
Pipe Size of Trap	Dollars lost per month when steam cost is $6.00 per 1,000 pounds				
1/2" bucket trap	$22	$32	$40	$48	$65
3/4"bucket trap	$34	$50	$63	$76	$65
1" bucket trap	$86	$129	$162	$194	$145

Pressure at Trap	2 psig	5 psig	10 psig	15 psig	25 psig
Pipe Size of Trap	Dollars lost per month when steam cost is $6.00 per 1,000 pounds				
Thermostat	$22	$32	$40	$48	$65
3/4" F&T trap	$22	$32	$40	$48	$65
1" F&T trap	$22	$32	$40	$48	$65
1-1/4" F&T trap	$34	$50	$63	$76	$65
1-1/2" F&T trap	$57	$85	$105	$129	$101
2" F&T trap	$86	$129	$162	$194	$228

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Maintenance of Steam Traps

Maintenance of Steam Traps

- Identification of faulty traps is a big problem at many facilities.
- Misdiagnosis can allow faulty traps to remain troublesome, and for working traps to be replaced needlessly.
- Accurate diagnosis is the most important part of any steam trap maintenance program.

Maintenance of Steam Traps

Warnings Signs of Steam Trap Failure:

- Abnormally warm boiler room.
- Condensate receiver is venting excessive steam.
- A condensate pump water seal is failing prematurely.
- Boiler operating pressure is difficult to maintain.
- Vacuum in return lines is difficult to maintain.
- Water hammer occurs.

Maintenance of Steam Traps

Maintenance Program:

- It is very important that plants have a steam trap maintenance program in place.
- Majority of plants do not even know how many steam traps they have.
- For facilities that do not have a regular maintenance schedule, it is common to find that approximately 15-30% of all steam traps have failed.

Maintenance of Steam Traps

Steam Trap Failure:

- Steam traps will typically fail in two different ways.
- The trap can stick in the closed position, which causes condensate to back up into the steam system.
  - Usually easily detectable, as this will cause a significant change in the operating conditions.
  - This can cause extreme damage to the steam system.
- The trap can also stick in the open position, allowing live steam to discharge into the condensate system.
  - This is how most steam traps will fail, which is why steam traps are amongst the largest energy wasters in many industrial facilities.

Maintenance of Steam Traps

Testing Methods

- **Visual:**
  - Visual inspection depends on a release valve situated downstream of certain traps.
  - These valves can be released, and checked to see if condensate or steam is released.

Maintenance of Steam Traps

Testing Methods

- **Acoustic:**
  - Involves listening to the steam trap operation, while ignoring any ambient sounds.
  - Devices that can be used include, stethoscopes, and ultrasonic leak detectors.
  - Ultrasonic devices are typically the best and most accurate choice. These instruments are basically electronic stethoscopes with acoustic filtering allowing them to be sensitive to high frequency sounds.

Maintenance of Steam Traps

Testing Methods

- **Thermal:**
  - Involves observing upstream/downstream temperature variations in the steam traps.
  - Infrared thermometers can be used to compare temperature differences.
  - This method is most effective when used in conjunction with an ultrasonic leak detector.

Conclusion

- Steam traps are an extremely important part on any steam system.
- Basic function is to allow condensate and non-condensable gases to escape, while holding steam in a device where a thermal or heat transfer process occurs.
- Steam traps like any mechanical device can and will malfunction.
- It is imperative that all facilities with steam traps, have a regular testing and maintenance program.

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QUESTIONS ????