Welcome

Presentation On Steam Traps

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Topics

- Introduction
- Types of Steam Traps
- Steam Trap Criteria Comparison
- Troubleshooting
- Inspection, Maintenance and Testing

Introduction

- Condensate is formed whenever steam gives up its enthalpy of evaporation (latent heat). The proper removal of condensate from steam plant of all types is vital if the plant is to work efficiently and this operation is commonly performed by a steam trap.
- Steam traps, which are vital in controlling and improving the efficiency of steam distribution and utilisation systems, normally found to be a neglected area.
- Developments and improvements in steam trap design and function have led to countless savings in energy,time and money.

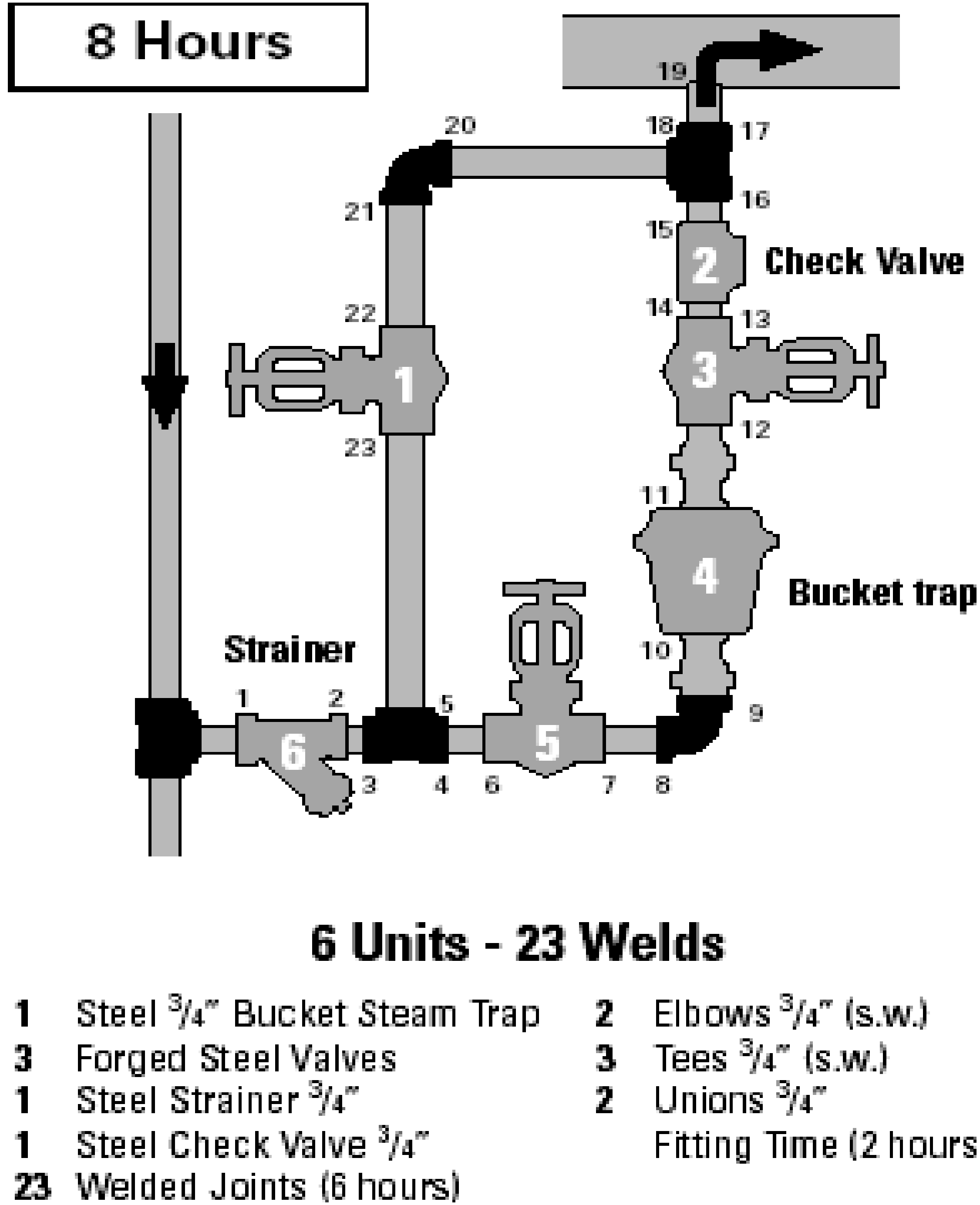
Condensate Drainage…Why It’s Necessary

- Excess condensate may lead to water hammering
- High-velocity water may erode fittings by chipping away at metal surfaces i.e to prevent erosion
- Potential barrier to heat transfer
- To prevent corrosion

Why air and non-condensables should be removed

- When air and other gases enter the steam system, they consume part of the volume that steam would otherwise occupy. The temperature of the air/steam mixture falls below that of pure steam.
- When non-condensable gases (primarily air) continue to accumulate and are not removed, they may gradually fill the heat exchanger with gases and stop the flow of steam altogether. The unit is then “air bound.”

- Steam traps are automatic valves that open to pass condensate and close to prevent the flow of steam.



What the Steam Trap Must Do

- The job of the steam trap is to get condensate, air and CO_2 out of the system as quickly as they accumulate
- Minimal steam loss. Table CG-3 shows how costly unattended steam leaks can be.
- Long life and dependable service Rapid wear of parts quickly brings a trap to the point of undependability. An efficient trap saves money by minimizing trap testing, repair, cleaning, downtime and associated losses
- Corrosion resistance. Working trap parts should be corrosion-resistant in order to combat the damaging effects of acidic or oxygen-laden condensate

Table CG-3. Cost of Various Sized Steam Leaks at 100 psi
(Assuming steam costs $5.00/1,000 lbs)

Size of Orifice (in)	Lbs Steam Wasted Per Month	Total Cost Per Month	Total Cost Per Year
1/2	835,000	$4,175.00	$50,100.00
7/16	637,000	3,185.00	38,220.00
3/8	470,000	2,350.00	28,200.00
5/16	325,000	1,625.00	19,500.00
1/4	210,000	1,050.00	12,600.00
3/16	117,000	585.00	7,020.00
1/8	52,500	262.50	3,150.00

What the Steam Trap Must Do

- Air venting . Air can be present in steam at any time and especially on start-up. Air must be vented for efficient heat transfer and to prevent system binding.
- CO2 venting .Venting CO2 at steam temperature will prevent the formation of carbonic acid. Therefore, the steam trap must function at or near steam temperature since CO2 dissolves in condensate that has cooled below steam temperature
- Freedom from dirt problems .Dirt is an ever-present concern since traps are located at low points in the steam system. Condensate picks up dirt and scale in the piping

MOC of Steam Trap

	Part	Materials
A	Body	Cast Carbon Steel WCB [C. Max 0.25]
B	Cover	Same as Body Material
C	Cover Gasket	Stainless Steel with Graphite Filler
D	Cover Stud & Bolt	Alloy Steel
E	Cover Nut	Carbon Steel

MOC of Steam Trap

	Part	Materials
F	Strainer	Stainless Steel
G	Seat	SS hardfaced Stellite 6
H	Strainer Cover Gasket	SS Spiral wound with graphite filler
I	Strainer Blow Down Plug	Carbon steel
J	Fixing Screw & Washer	Stainless Steel

Types of Steam Traps

- The difference between condensate and steam is sensed in several ways. One group of traps detect the difference in density, another group react to a difference in temperature, and a third rely on the difference in flow characteristics

Generally Traps are classified as follows:

- Thermostatic traps react to the difference in temperature between steam and condensate.
- Mechanical traps operate by the difference in density between steam and condensate.
- Kinetic traps rely on the different inflow characteristics of steam and condensate.

Mechanical Steam Traps

The name “mechanical steam trap” is usually given to traps that operate on the difference in density between condensate and steam. The operating member is normally a closed float or an open bucket connected to a valve which regulates the discharge

- e.g. Float Traps, Bucket traps

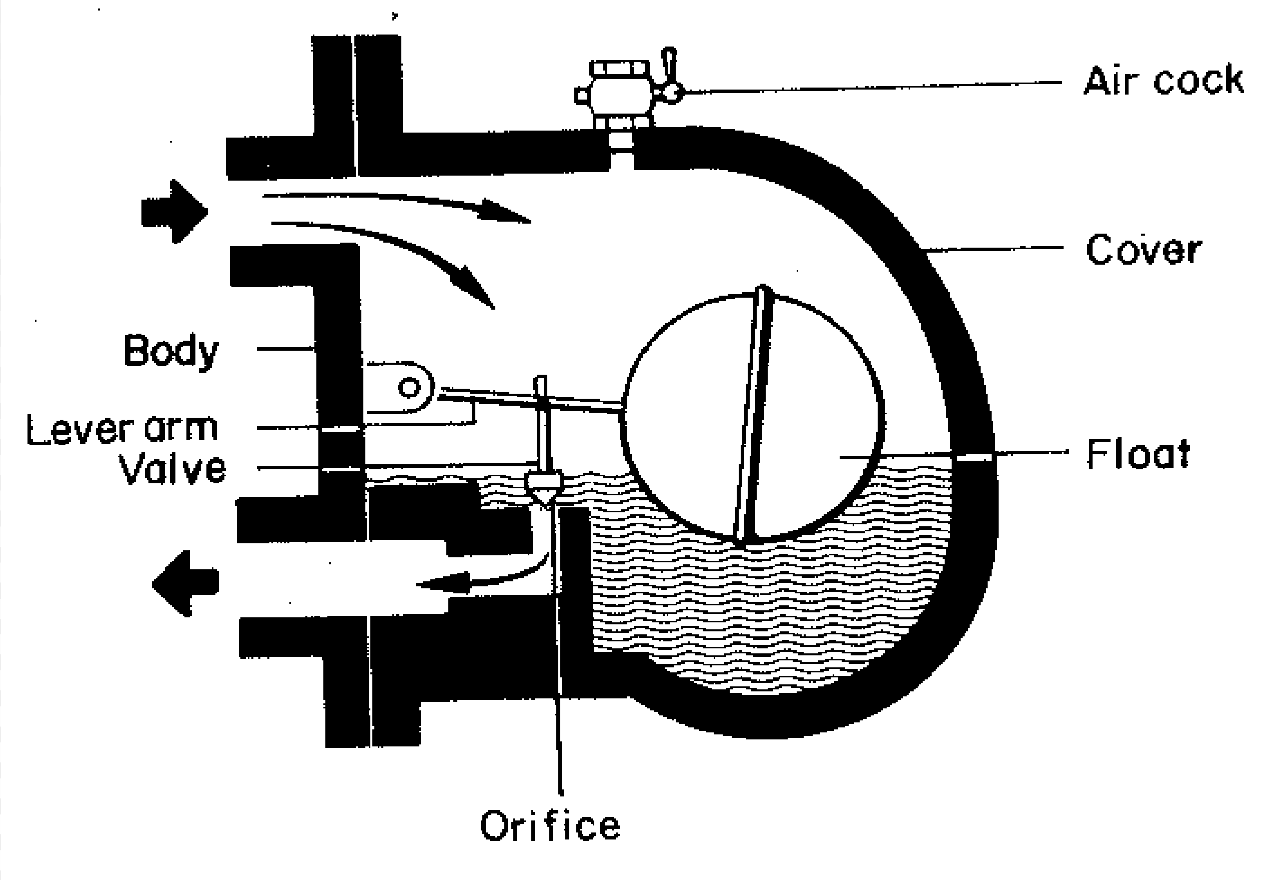
Float Traps

When steam is first turned on to the plant, the float is in its lowest position and the valve is closed. The incoming steam will try to force air in the steam space towards the trap, from which it cannot escape unless the air cock on the top of the body is opened. As the condensate level rises, the buoyancy of the float has to pull the valve off its seat against the force exerted by the steam pressure. Because of this, many float traps use a lever mechanism between the float and the valve to multiply the available effort. A separate thermostatic element at the top of the trap controls the discharge of air or other non-condensable gases from the trap.

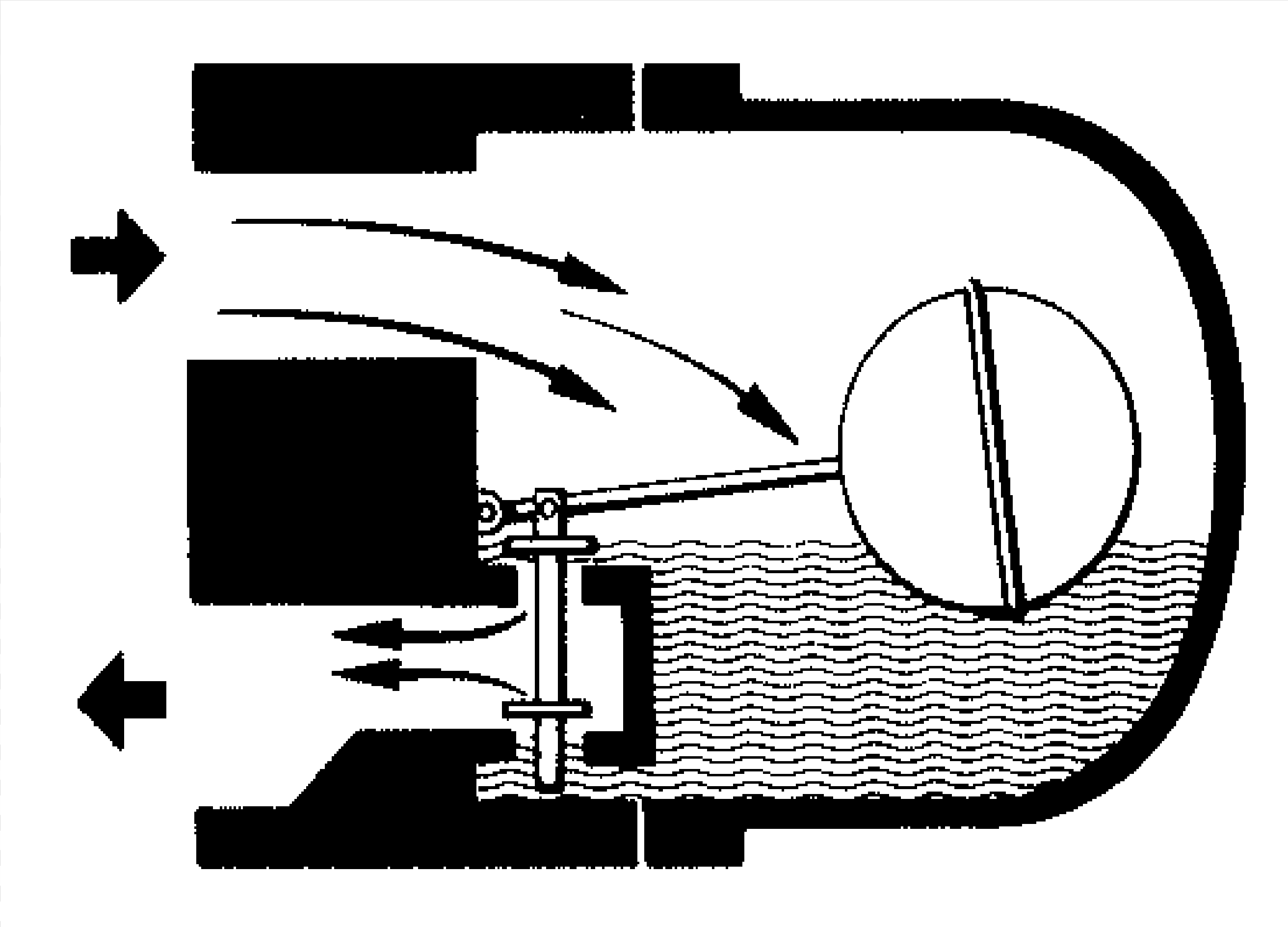
Examples:

- Simple Trap
- Float Trap with Double-seated Valve
- Free Float Trap
- Float Trap with Thermostatic Air Vent

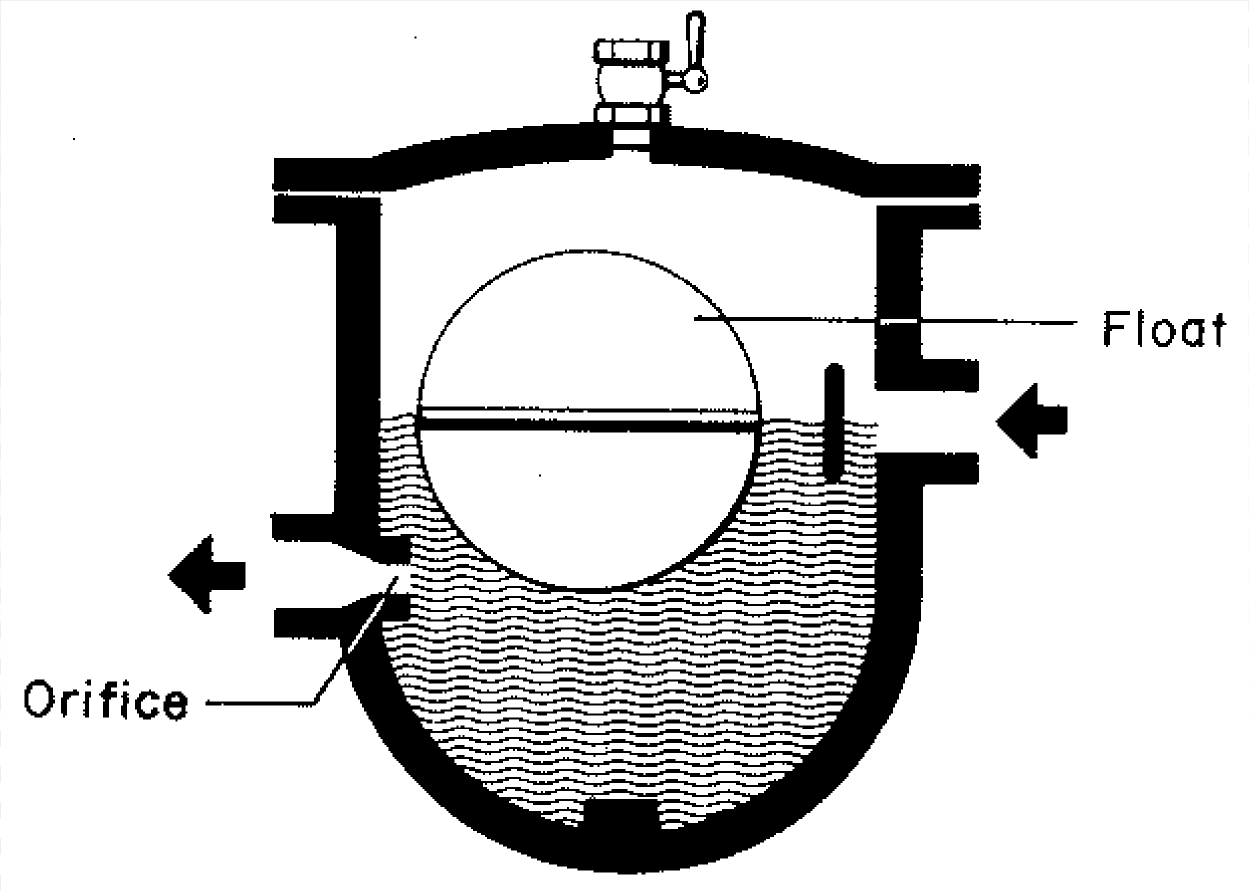
Simple Float Trap



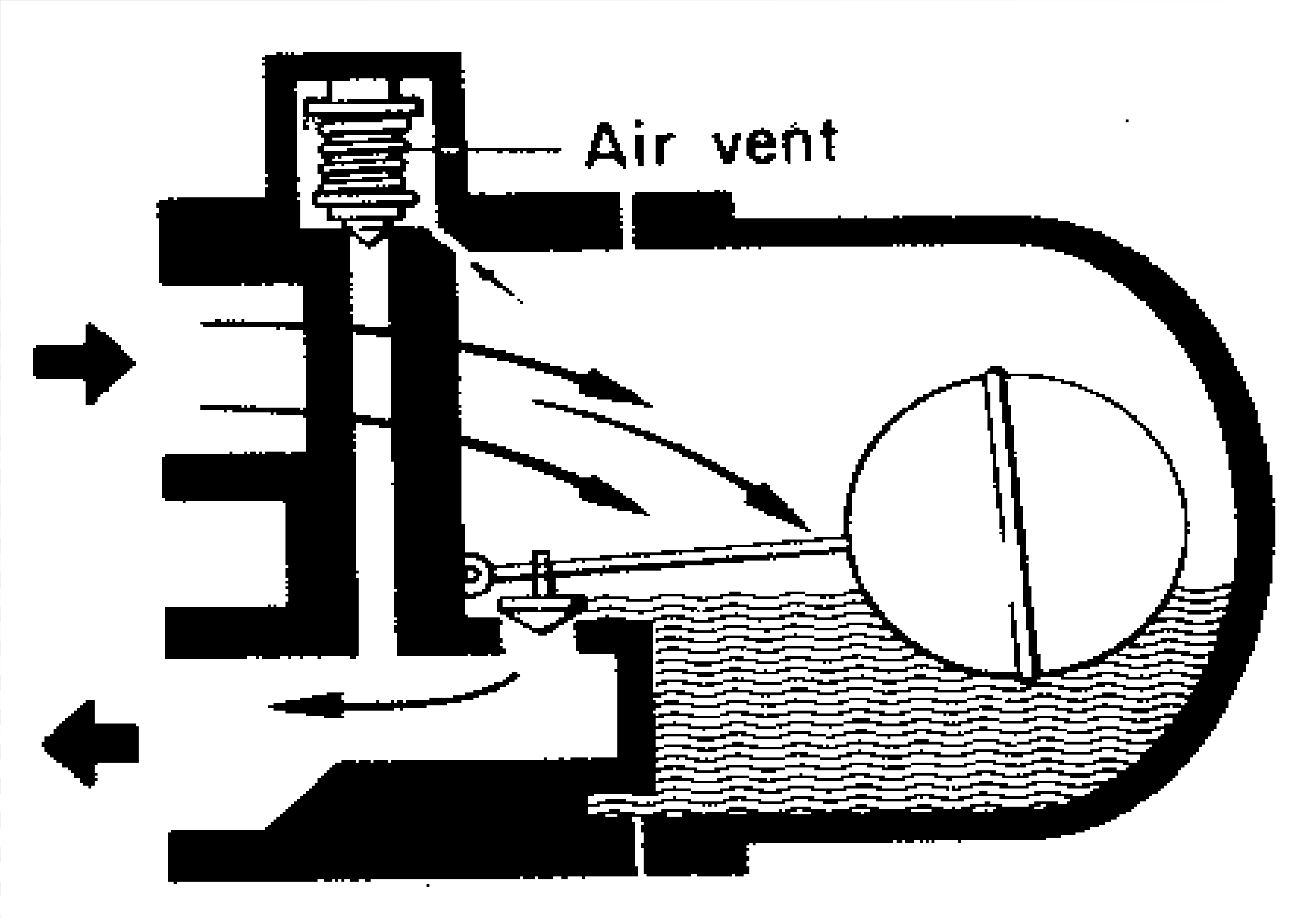
Float Trap with Double-seated Valve



Free Float Trap



Float Trap with Thermostatic Air Vent



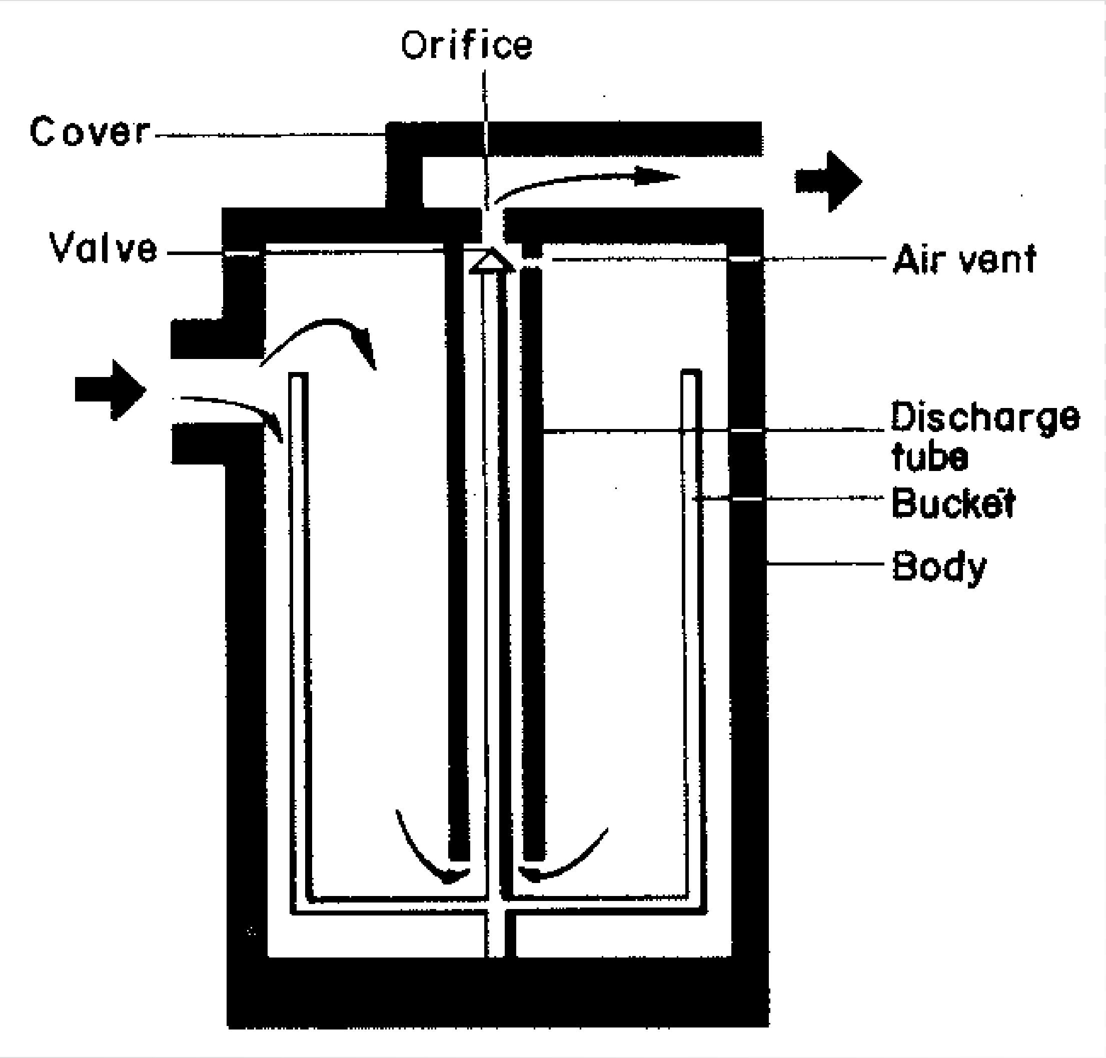
Bucket Traps

- Like float traps, bucket traps also use buoyancy to differentiate between condensate and steam. Instead of a closed float, they are fitted with a bucket open at one end. Open-top bucket traps have the open end of the bucket at the top, whereas inverted bucket traps have it at the bottom.
- Examples:
- Open-top Bucket Traps
- Inverted Bucket Traps

Open-top Bucket Traps

When the trap is first installed, the bucket which is empty, rests on the bottom of the body and the valve is open. The air enters the bucket, passing up the discharge tube and out through the open valve. Condensate then starts to fill the body of the trap and eventually the bucket floats, shutting the valve. Condensate continues to collect in the body until it reaches the top lip of the bucket, over which it flows. When the weight of water in the bucket is sufficient to overcome the buoyancy and pull the valve off its seat against the steam pressure, the bucket sinks and the trap discharges. Steam pressure forces the water in the bucket up the discharge tube and out through the valve orifice, until the bucket regains its buoyancy, when it floats and shuts the valve again.

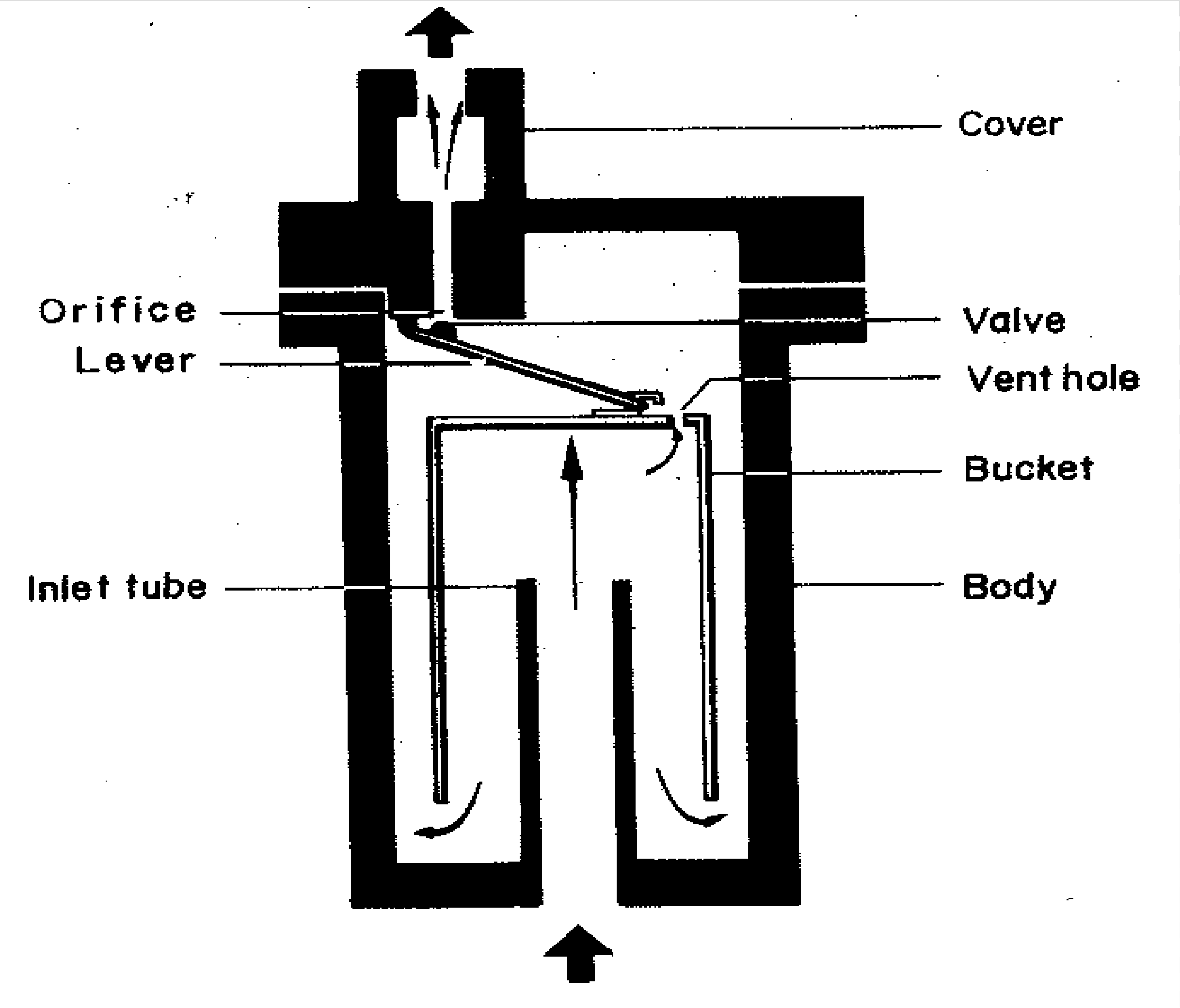
Open-top Bucket Trap



Inverted Bucket Traps

- Before steam is turned on, the bucket rests on the bottom of the body and the valve is wide open.Condensate then fills the body and the bucket and also flows out through the orifice because the valve is still wide open. When steam reaches the trap, it enters the bucket and a small amount passes through the vent hole and out through the open valve. Most of the steam displaces water from inside the bucket and the latter becomes buoyant and floats, closing the valve.
- The steam trapped in the top of the bucket will now pass very slowly through the vent hole and condense in the water in the trap body. Condensate at the inlet to the trap will gradually fill the bucket as the trapped steam escapes through the vent hole and, when the buoyancy has been lost, the bucket will drop, pulling the valve off the seat orifice against the steam pressure. The trap will then discharge and the cycle will be repeated. If there is no condensate to be discharged, live steam will replace that which is condensed in the water in the body.

Inverted Bucket Trap



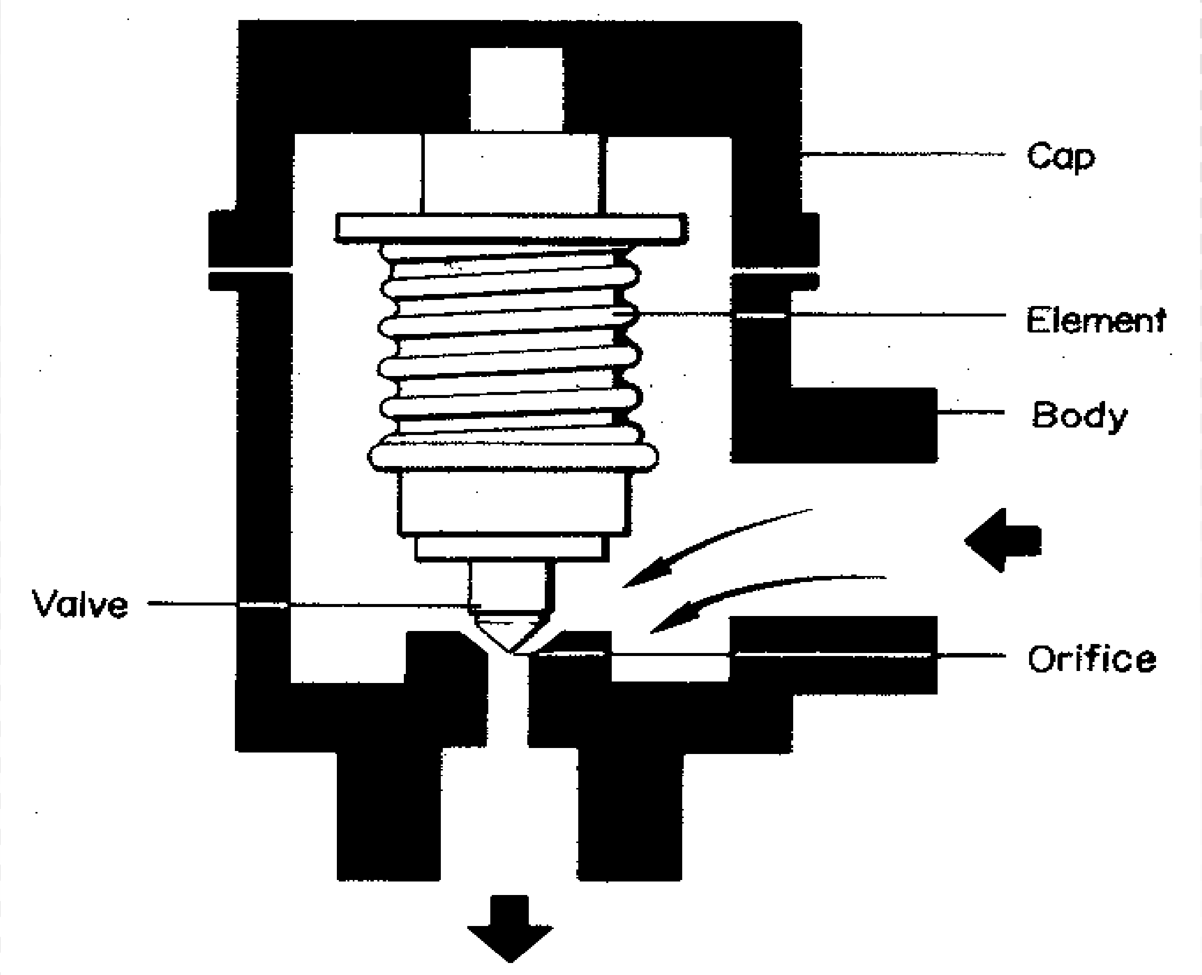
Thermostatic Traps

- Thermostatic traps differentiate between steam and condensate by sensing a difference in temperature. When steam condenses, the condensate is initially at the same temperature as the steam. To provide a temperature difference to operate a steam trap, the condensate must lose some of its heat. Therefore, unlike mechanical traps, thermostatic traps must hold back the condensate before discharge while the temperature falls. This is an important factor to be remembered when selecting and installing these traps.
- Balanced pressure design
- Bimetallic steam trap

Balanced Pressure Thermostatic Trap

- Balanced pressure thermostatic steam traps open and close via the expansion and contraction of a temperature sensitive element that responds to the lower temperatures created by condensate and noncondensable gases in the trap. The operating unit within the trap, a pressure-balanced disc or bellows, is filled with a liquid(e.g. alcohol or a mixture of alcohol and water) which boils at a lower temperature than water. With rising temperatures in the trap, the liquid contained in the active element evaporates. The resulting internal pressure causes the bellows or disc to expand and close the valve. As condensate or air enter the trap, the temperature within the trap decreases allowing some of the liquid in the bellows to condense, which reduces the pressure inside the bellows. This reduction in pressure causes the bellows to contract and open the valve

Balanced-pressure Thermostatic Trap



Bimetallic Steam Trap

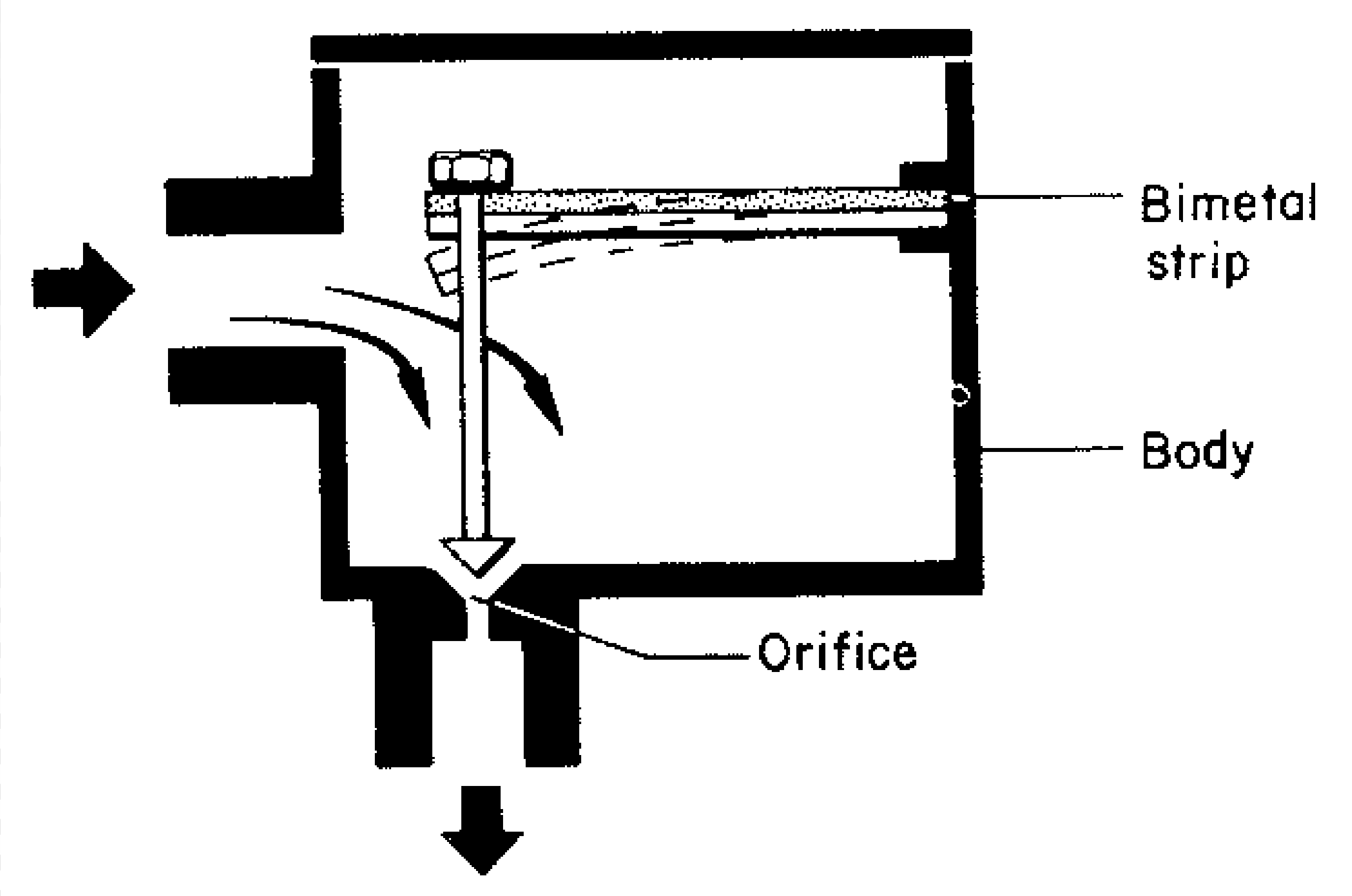
Principle: If two metals, having different coefficients of expansion, are bonded together and heated, the composite piece will take up a curved shape with the metal that has expanded most on the outside. On cooling down the original shape will be regained.

- When cold, the bimetal strip is straight and the valve is wide open. Steam is turned on and air and cool condensate pass freely out through the wide open valve. As the condensate warms up, the bimetal bends until the valve closes off the seat. When the condensate surrounding the bimetal cools, the strip straightens out and eventually pulls the valve off the seat against the steam pressure. Bimetal traps normally have the valve on the outlet side of the orifice so that the force exerted by the steam pressure helps the valve to open

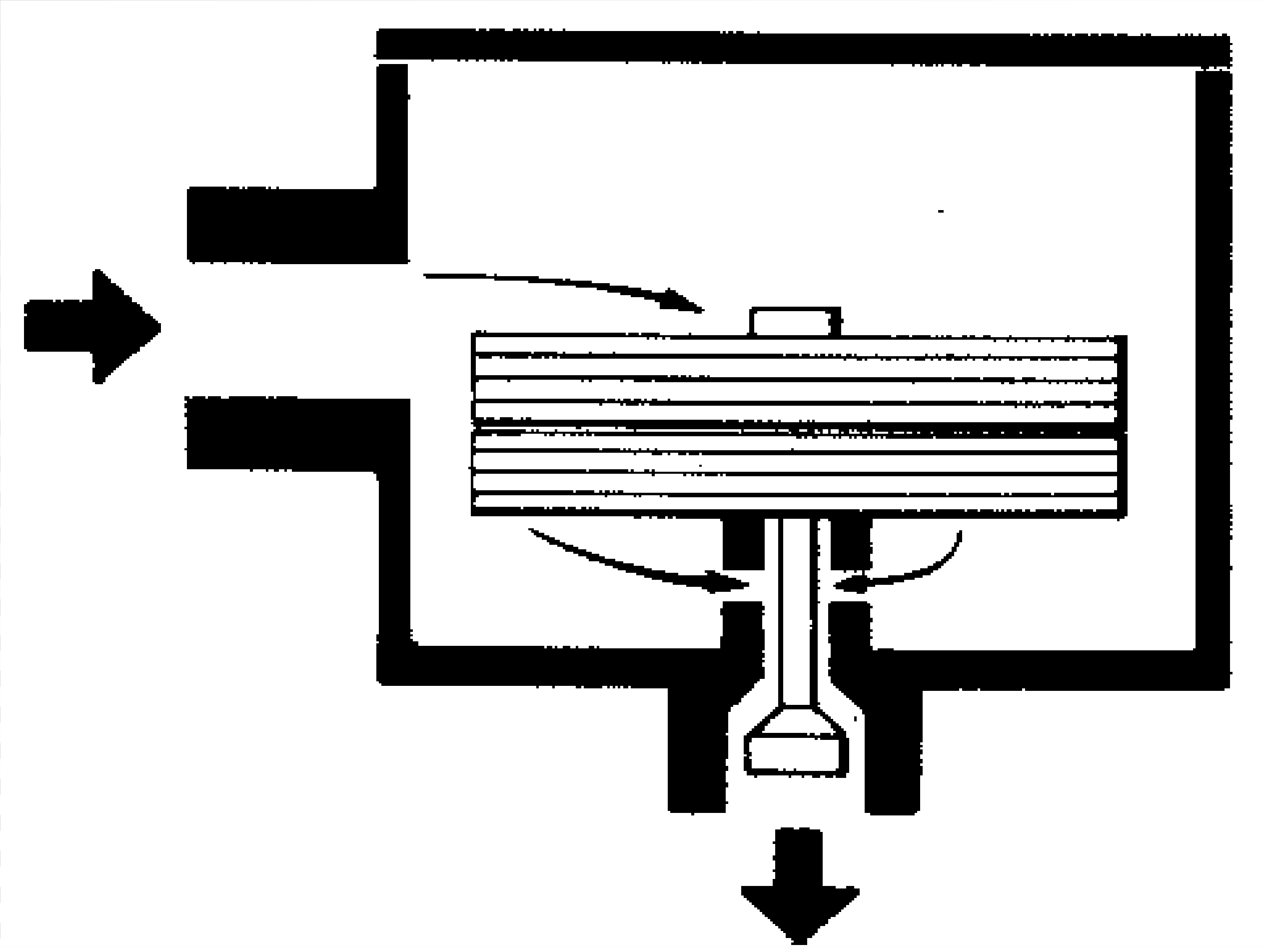
Types of Bimetallic Steam Trap

- Simple Bimetal Trap
- Bimetal Trap with Open Downstream Valve
- Bimetal Trap with Closed Downstream Valve
- Bimetal Trap with Disc and Spring Element
- Cantilever Bimetal Element

Simple Bimetal Trap

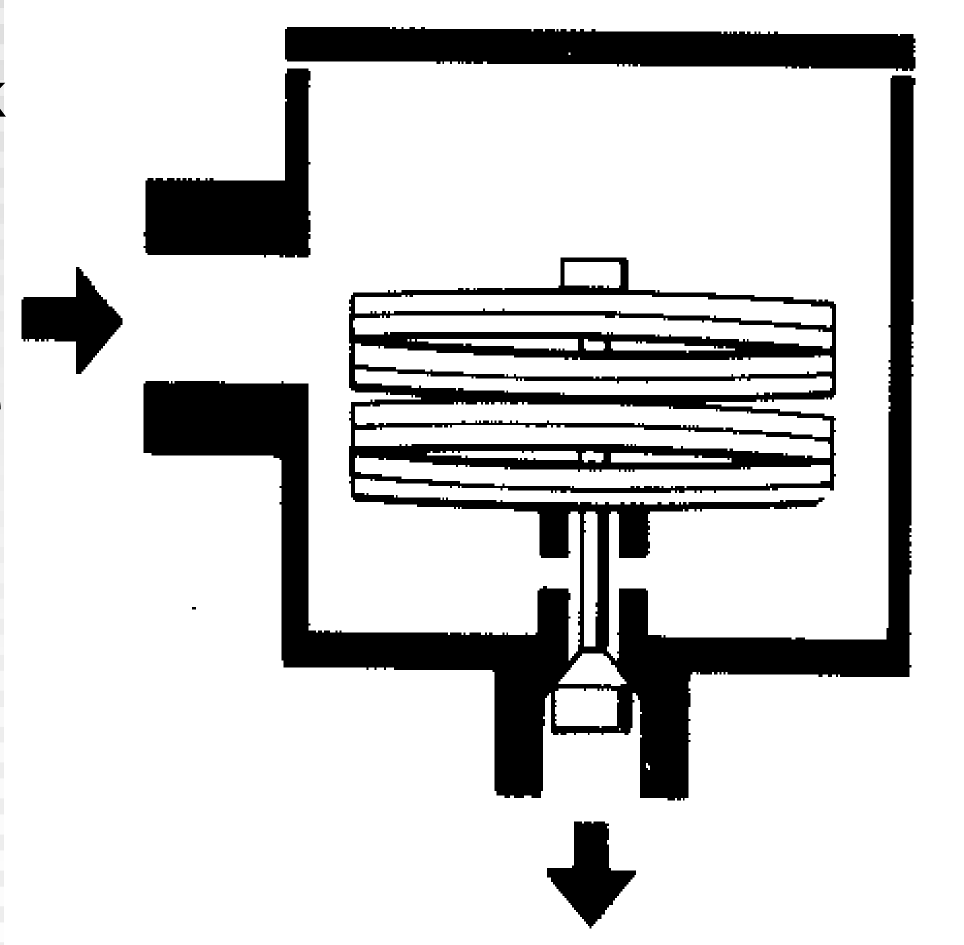


Bimetal Trap with Open Downstream Valve



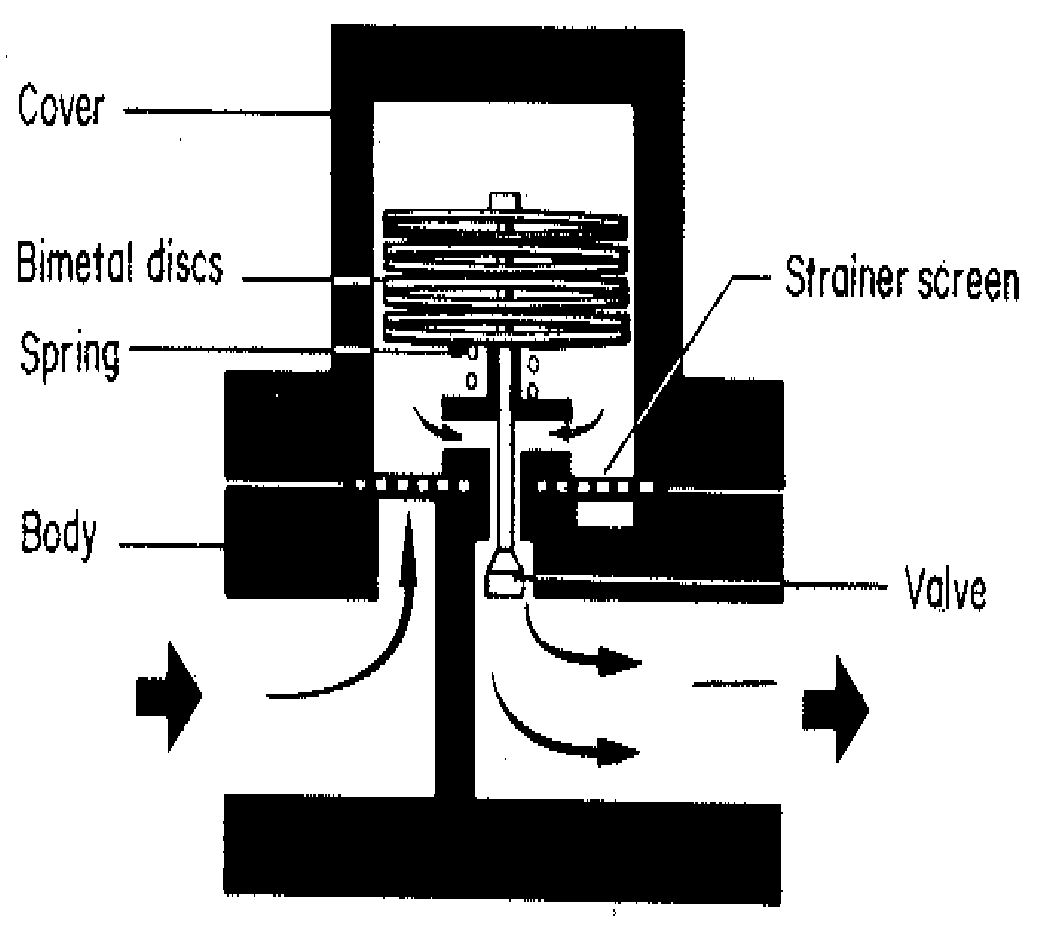
Bimetal Trap with Closed Downstream Valve

The element consists of a stack of bimetal discs, arranged in opposed pairs, operating a valve on the outlet side of the seat orifice. When the discs are cold they are flat, allowing the valve to open wide. As the temperature rises, the pairs of discs blow in opposite directions and close the valve



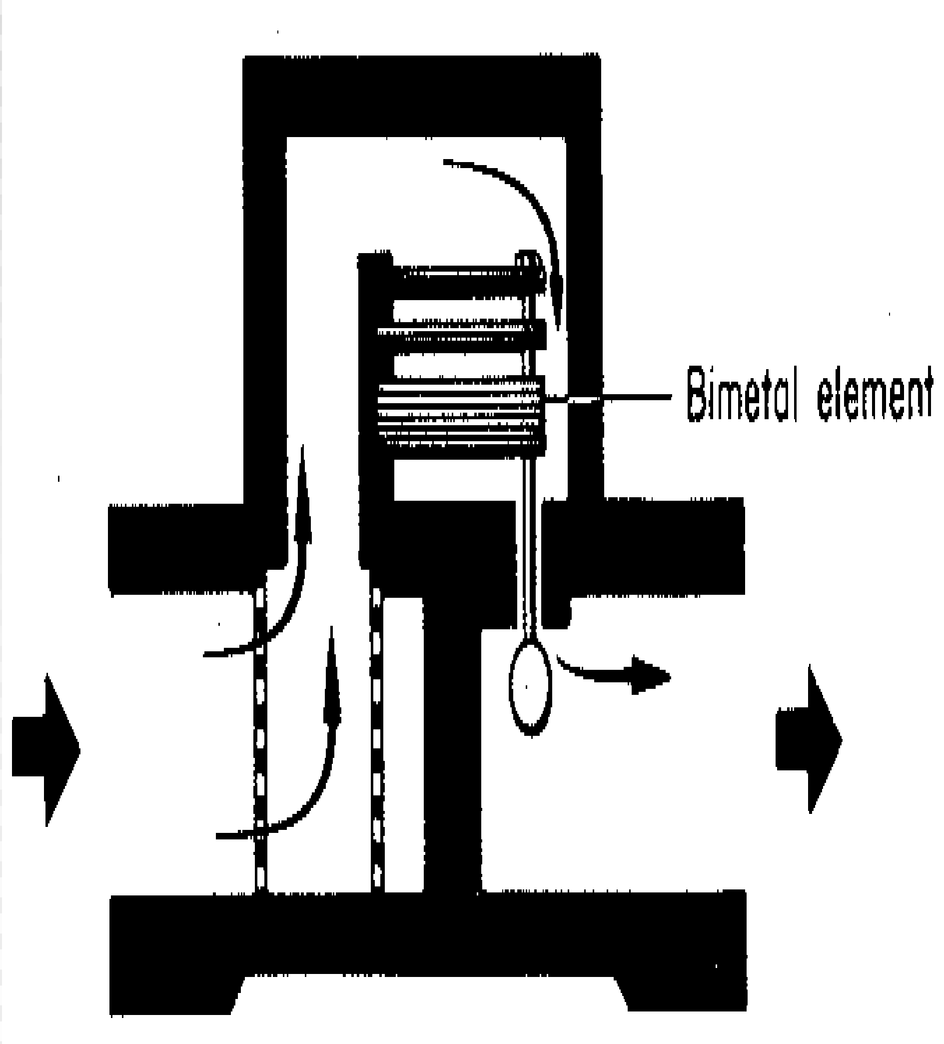
Bimetal Trap with Disc and Spring Element

The spring is arranged to compress and absorb some of the force of the bimetal in the lower part of the pressure range



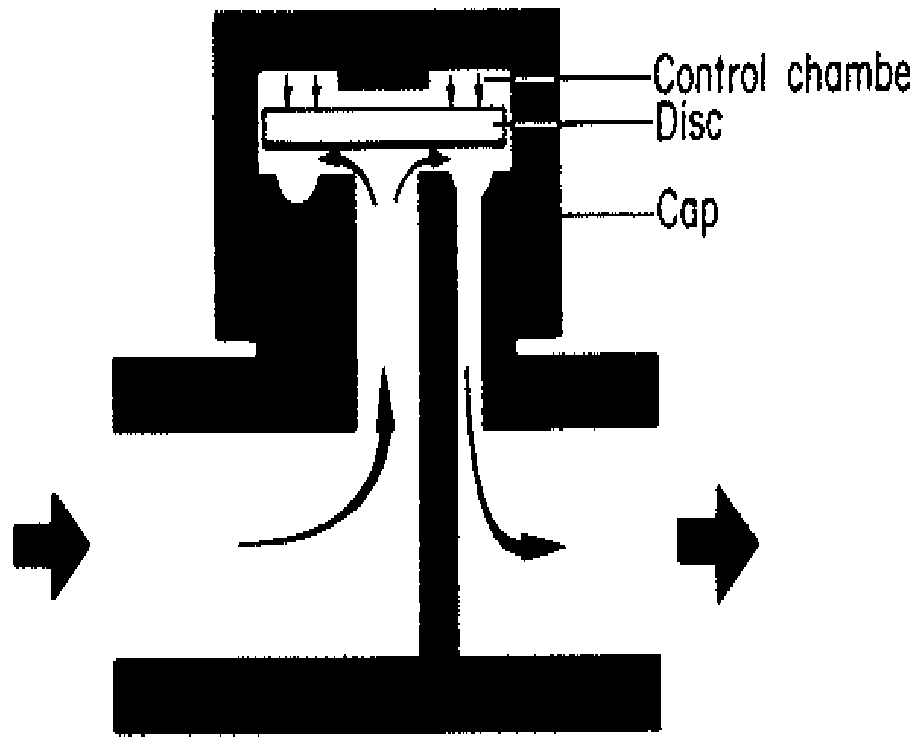
Cantilever Bimetal Element

Here the element consists of several bimetal strips of different thicknesses forming a cantilever and coming into operation in sequence, producing a force on the valve which increases in steps as the pressure and temperature rise. Elements of this type require quite a lot of bimetal to provide the required force and can be rather slow to react to varying conditions



Thermodynamic Steam Trap

These traps have a disc that rises and falls depending on the variations in pressure between steam and condensate. Steam will tend to keep the disc down or closed. As condensate builds up it reduces pressure in the upper chamber and allows the disc to move up for condensate discharge.



Steam Trap Criteria Comparison

Steam Trap Criteria Comparison

CRITERIA	F&T	Inverted Bucket	Thermostatic	Thermodisc
Response to Load Changes	Fast	Moderate	Moderate	Slow
Air Venting	Medium/High	Low	High	Low
Thermal Efficiency	Medium/High	Medium	High	Medium
Primary Applications	Drip Legs Process Equip.	Drip Legs Process Equip.	Drip Legs Process Equip. Tracing	Drip Legs Tracing
Affected by Ambient Temperatures	No (Susceptible to freezing)		No	Yes (unless insulated)
Relative Cost	Medium/High	Medium/Low	Low	Low
Capacity	High	High	Medium	Low
Pressure Range	to 250 psig (17.3 bar)	to 250 psig (17.3 bar)	to 125 psig (8.6 bar)	to 600 psig (41.4 bar)
Size vs. capacity	Large	Large	Small	Medium
Ease of Maintenance	Moderate	Moderate	Very Easy	Very Easy
Orientation limits	Yes	Yes	No	No

Steam Trap Application Guide

APPLICATION	F&T	Inverted Bucket	Thermostatic	Thermodisc
Mains & Tracing Lines				
Steam Mains				
to 30 psig (2.1 bar)	2	3	1	
to 250 psig (17.3 bar)	1	2		3
to 600 psig (41.4 bar)				1
Steam Tracing Lines				
Critical	2	2	2	1
Non-Critical	2	2	1	2
HVAC				
Heat Exchangers				
to 20 psig (1.4 bar)	1	2	2	
to 125 psig (8.6 bar)	1	2	2	
to 250 psig (17.3 bar)	1	2		
Radiators			1	
Unit Heaters	1	2	1	
Air Heating Coils				
to 15 psig (1.0 bar)	1	3	2	
to 60 psig (4.1 bar)	1	2	2	
Absorption chiller	1	2	2	
PROCESS EQUIPMENT				
Process Vats	1			2
Tank Heating				
Storage Tanks	2		1	
Line Heaters	1		2	
Reboiler	1	2		
Rotating Cylinders	1	2		
Evaporators	1	2		
Sterilizer	1		2	
Pressing	1	2	1	
Cooker/Reactor				
to 15 psig (1.0 bar)	1	3	2	
to 60 psig (4.1 bar)	1	2	1	
to 150 psig (10.1 bar)	1	2		

KEY: 1 = First Choice
2 = Second Choice
3 = Third Choice
Blank = Not Recommended

Troubleshooting

- **No Discharge**

If the trap fails to discharge condensate, then

A. Pressure may be too high

1. Pressure raised without installing smaller orifice
2. PRV out of order
3. Pressure gauge in boiler reads low
4. Orifice enlarged by normal wear
5. High vacuum in return line increases pressure differential beyond which trap may operate

Troubleshooting

B. No condensate or steam coming to trap

1. Stopped by plugged strainer ahead of trap
2. Broken valve in line to trap
3. Pipe line or elbows plugged

C. Worn or defective mechanism

1. Repair or replace as required

D. Trap body filled with dirt

1. Install strainer or remove dirt at source

Troubleshooting

E. For IB,bucket vent filled with dirt. Prevent by :

1. Installing strainer
2. Enlarging vent slightly
3. Using bucket vent scrubbing wire

Note:

- For F&T traps, if air vent is not functioning properly, trap will likely air bind
- For thermostatic traps, the bellows element may rupture from hydraulic shock, causing the trap to fail closed

Troubleshooting

- Steam Loss

Causes:

A. Valve may fail to seat.

1. Piece of scale lodged in orifice
2. Worn parts

B. IB trap may lose its prime

1. If the trap is blowing live steam, close the inlet valve for a few minutes. Then gradually open. If the trap catches its prime, chances of trap is all right
2. Prime loss is usually due to sudden or frequent drops in steam pressure. On such jobs, the installation of a check valve is called for.

C For F&T and thermostatic traps, thermostatic elements may fail to close

Troubleshooting

- **Continuous Flow**

If an IB or disc trap discharges continuously, or an F&T or thermostatic trap discharges at full capacity, check the following:

A. Trap too small

1. A larger trap, or additional traps, should be installed

2. High pressure traps may have been used for a low pressure job. Install right size of internal mechanism

B. Abnormal water conditions

1. Boiler may foam or prime, throwing large quantities of water into steam lines

2. A separator should be installed or else the feed water conditions should be remedied

Troubleshooting

- **Sluggish Heating**

When trap operates satisfactorily, but unit fails to heat properly:

A. One or more units may be short-circuiting.

1. The remedy is to install a trap on each unit.

B. Traps may be too small for job even though they may appear to be handling the condensate efficiently.

1. Try next larger size trap.

C. Trap may have insufficient air-handling capacity, or theair may not be reaching trap.

1. In either case, use auxiliary air vents.

Troubleshooting

- **Mysterious Trouble**

If trap operates satisfactorily when discharging to atmosphere, but trouble is encountered when connected with return line, check the following:

A. Back pressure may reduce capacity of trap.

1. Return line too small—trap hot.
2. Other traps may be blowing steam—trap hot.
3. Atmospheric vent in condensate receiver may be plugged—trap hot or cold.
4. Obstruction in return line—trap hot.
5. Excess vacuum in return line—trap cold.

Steam Trap Maintenance

- Steam traps generally work under arduous conditions, handling a mixture of steam and condensate, and are fitted in such a position that they form a natural repository for any dirt in the system. Because they contain moving parts, steam traps will eventually wear and, like any other mechanism, require regular maintenance if they are to continue working efficiently.
- As an indication of the amount of energy that can be wasted by a blowing steam trap, an orifice of diameter 5 mm can pass 0.017 kg/s of steam at a pressure differential of 8 bar. This is equivalent to wasting about 25 tons of fuel oil in a working year of 6000 hours.

Steam Trap Maintenance

- **Recommended Steam Trap Testing Intervals**

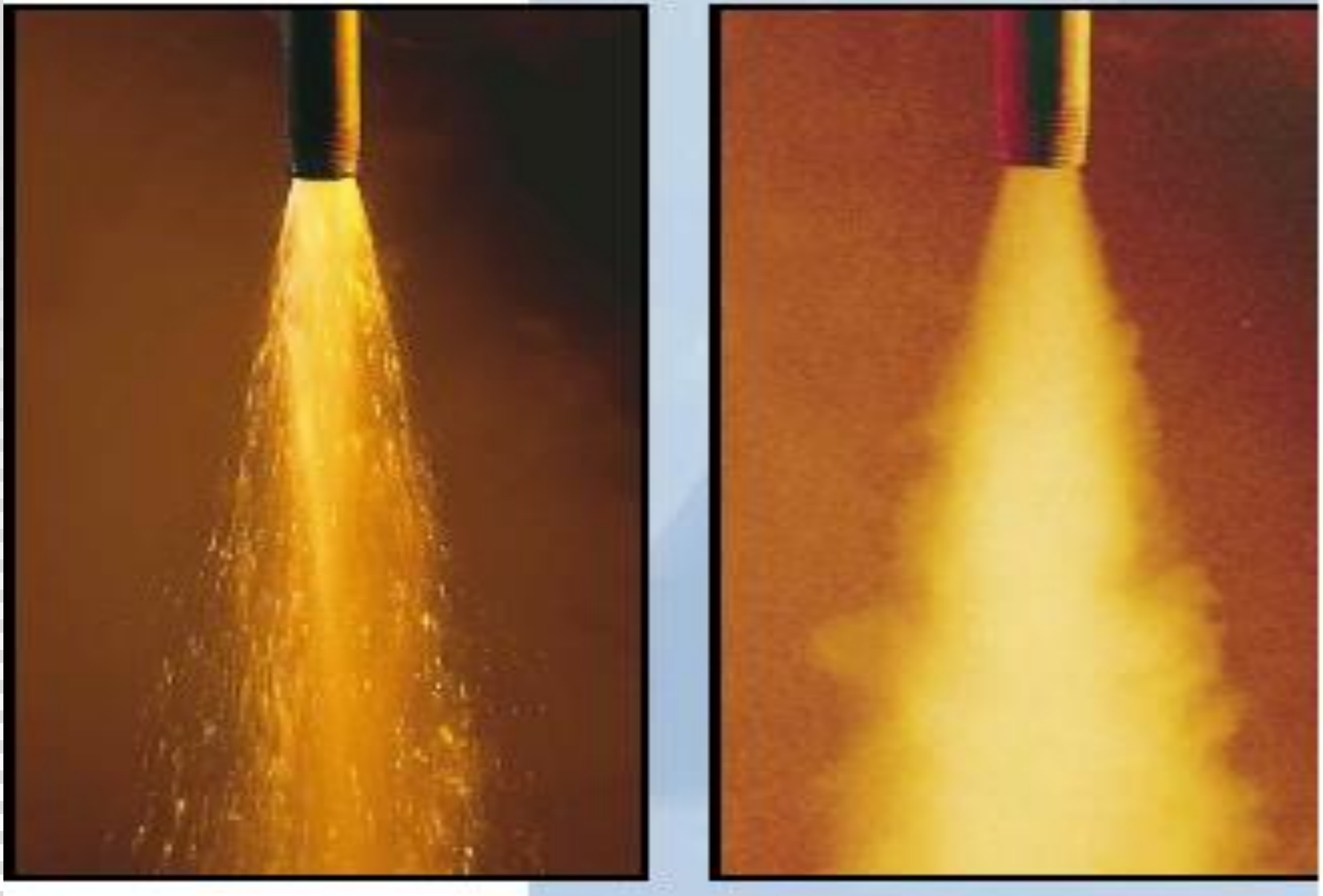
- High Pressure (150 psig and above): Weekly to Monthly
- Medium Pressure (30 to 150 psig): Monthly to Quarterly
- Low Pressure (Below 30 psig): Annually

Test Systems

Steam traps can be tested during operation by using

- Visual Observation
- Sightglasses (Vaposcopes)
- Ultrasonic Listening Devices
- Computerized Trap Test

Visual Observation



Visual observation of condensate discharge
(flash steam-left, live steam-right) helps determine
trap performance.

A Vaposcope is a double-sided sight glass that allows visual supervision of flow conditions in pipelines.

Working:

Where steam and condensate are present, the steam will pass over the top of the condensate because of its lower density. The internals of the Vaposcope include a flow deflector and condensate basin to aid recognition of the mixture of steam and condensate within the pipe. Steam and condensate are forced through the basin by the deflector. Normal operation is indicated by slight turbulence and a condensate level that just covers the bottom of the deflector. Higher steam flow rates, indicating a leaking or blowing trap, will create more turbulence and depress the condensate level below the deflector. If no turbulence is seen and the deflector is completely covered with condensate, a downstream blockage has occurred, potentially by a failed or undersized steam trap.

Ultraphonic Detector

- Portable, hand-held instrument
- **Operating Mechanism:** The flow of steam or condensate through a steam trap creates turbulence, which results in ultrasound. Ultrasonic frequencies between 20 and 100 kHz are detected, measured, and converted to audible frequencies between 100 Hz and 3 kHz. By converting the ultrasonic frequencies generated by an operating steam trap into the audible range, the Ultraphonic allows users to hear through a headphone and see on a meter sound characteristics that allow an assessment of a steam trap's condition
- The unit operates in a fixed frequency range. The user must be trained to identify and differentiate between the sounds expected from a properly functioning trap and the sounds from a trap that has failed close, failed open, or is leaking steam

Ultra Phonic Detector

Using the latest technology, FTI's experts thoroughly diagnose steam trap performance.

Computerized Trap Test

The system consists of a hand-held measuring transducer, a portable computer, and Trap Test software. Compatibility with a Windows NT operating system (previously DOS).

- Data are collected by placing the transducer tip on the steam trap. The specific point depends on the trap type and make. Ultrasonic vibrations are converted by the transducer to electrical pulses and transmitted as digital pulses to the computer. The signal is presented on a screen and can be printed or stored electronically for future comparisons with additional tests. Data collection requires about 10-25 seconds. Based on the ultrasonic signal recorded, the computer determines whether the steam trap is leaking steam or not. Data can be stored for up to 1100 traps per removable data storage cards. In addition to diagnostic results, survey dates, trap characteristics, location information, and tester comments can be stored. The software will also automatically prepare repair orders

Thank you