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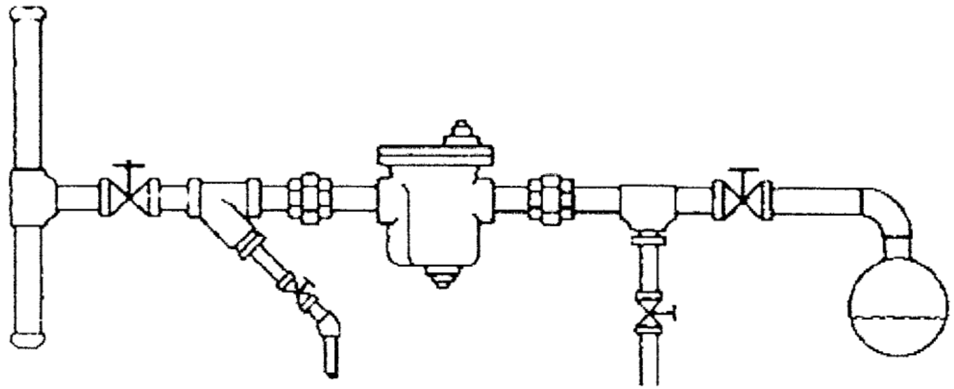

A Practical Guide to Implementing Effective Steam Trap Maintenance Programs to Reduce Energy Consumption & Greenhouse Gas Emissions

Presented by:

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Steam Trap Systems Inc.

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National Grid

Characteristics of Steam

Steam is an very efficient and easily controlled heat transfer medium. It is most often used to transfer heat from a central location (boiler) to a number of locations in a plant where it is used to heat air, water, or process applications (laundry, cooking, sterilization, drying, petroleum cracking, etc.).

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Characteristics of Steam

Steam is an invisible Gas generated by adding heat energy to water in a boiler.

The heat added to raise the temperature of the water to its boiling point is called "sensible heat".

The heat required to convert water at boiling point to steam at the same temperature is called "latent heat".

1 BTU = The amount of heat required to raise the temperature of one pound of water one degree Fahrenheit at atmospheric pressure.

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Characteristics of Steam

It takes 142 BTU to raise a pound of water from 70 F to 212 F.

It takes 970 BTU to convert a pound of water to steam at same temperature.

Steam volume is 1603X greater than the volume of water from which it's created!

A cubic foot of water (approximately 62.4 lbs.) would fill a 10' x 10' x 16' room full of Steam!

Highest Pressure Steam can exist = 3206.2 psia

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Steam Trap, noun;

An automatic valve that discharges condensate, air, and other non-condensable gases while "Trapping" steam from traveling beyond its intended point of use.

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"Steam Traps are the most ignored component critical for steam systems to operate both efficiently and safely".

Thomas Stanton, Professor; Massachusetts Maritime Academy

- 25+ years teaching Steam & Auxiliary Systems
- 25+ years inspector for Hartford Boiler Insurance Co.

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The Problem: *Steam Traps waste vast amounts of energy when they fail open. When they fail closed, water hammer conditions occur and system damage is eminent!*

The Challenge: *Maintenance Crews continue to dwindle in size, fewer & fewer personnel have experience with steam, Steam traps are located everywhere and anywhere and repairing or replacing Steam traps is a dirty job nobody wants to do!*

The Solution: *In 2010, National Grid began providing aggressive incentives (rebates) for those utilizing steam to take advantage of!*

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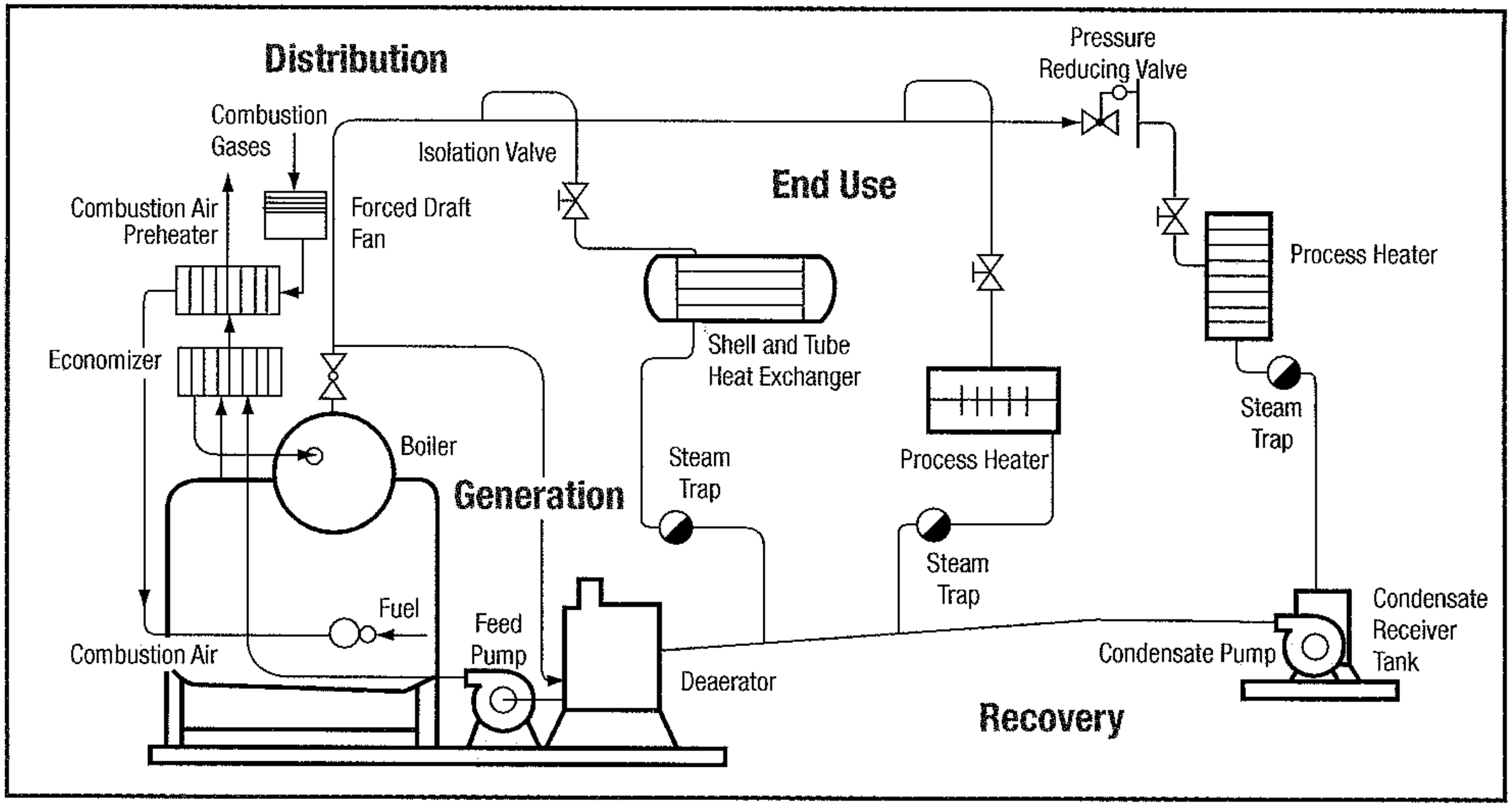

Typical Steam Generation-Distribution-Recovery Diagram

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Three categories of steam traps:

Mechanical

Thermostatic

Thermodynamic

Mechanical Steam Traps

The function of mechanical steam traps is based upon the fact that low density steam will exist above higher density condensate when both fluids are in a common container.

Two common mechanical steam traps are:

Inverted Bucket Trap

Float Trap

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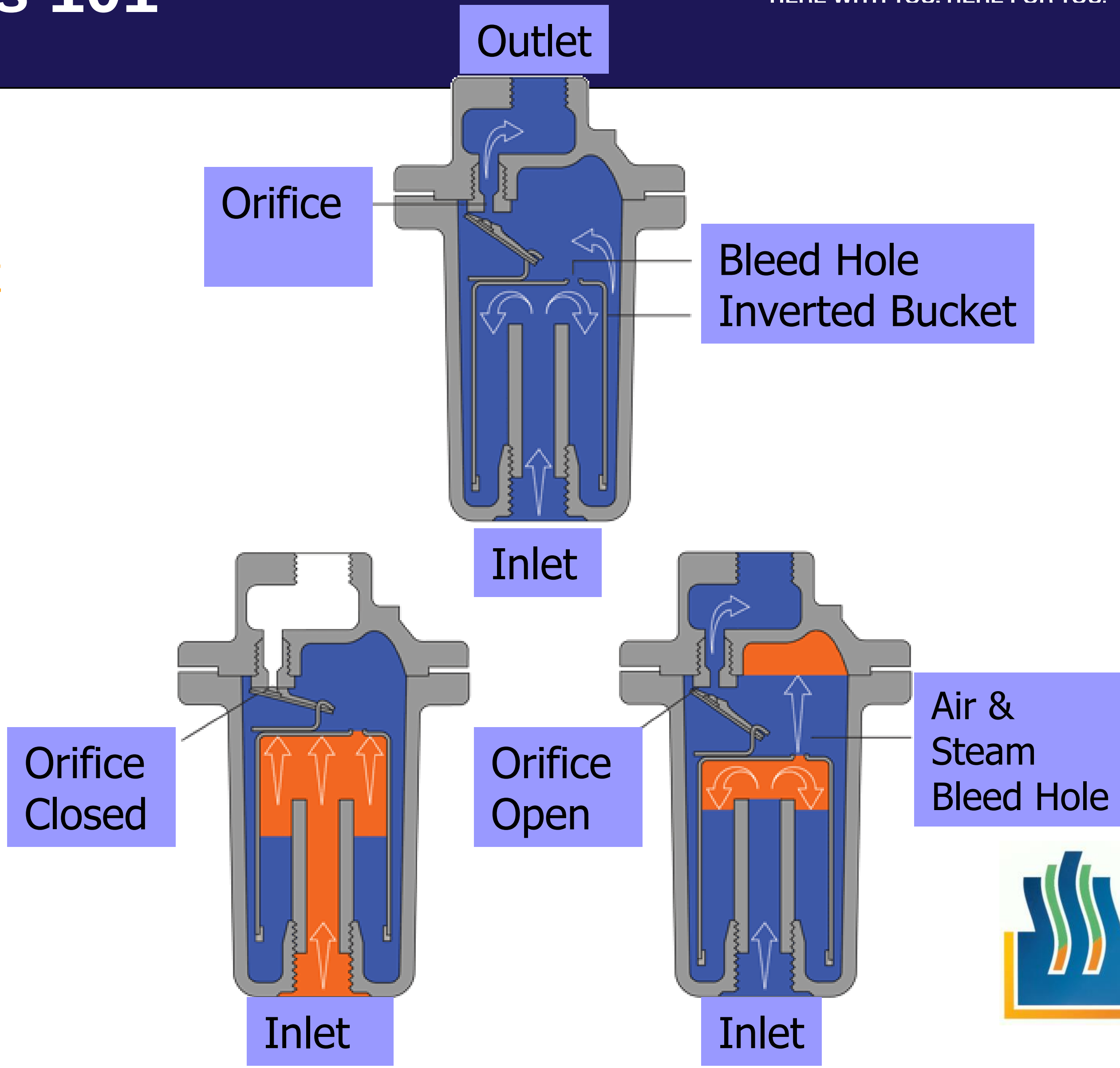
Inverted Bucket

Steam Traps



Inverted Bucket Steam Traps

Advantages:

Rugged, can be used with super heated steam/high pressure systems, high dirt load capacity, water hammer resistant.

Disadvantages:

Poor air handling, must maintain water seal, not freeze proof, high inventory requirements.

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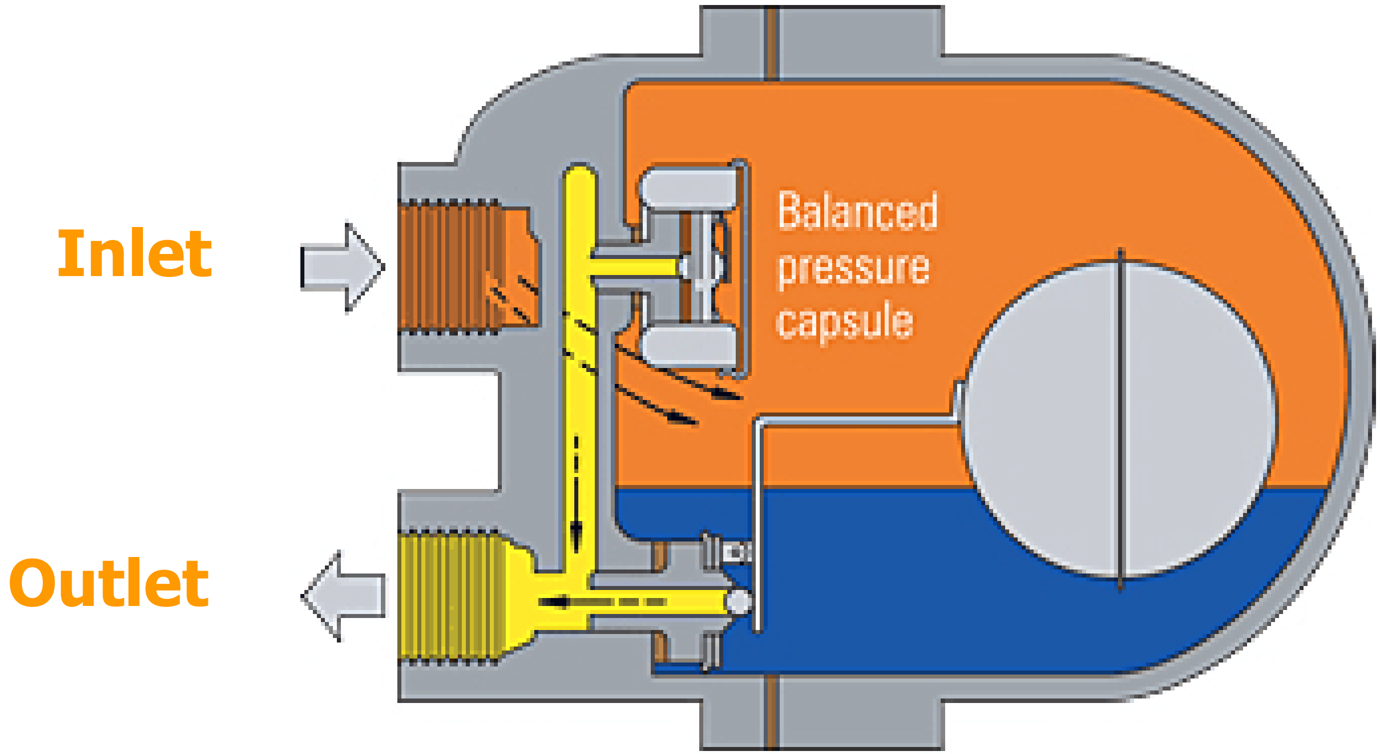
Float & Thermostatic Steam Traps



Float & Thermostatic Steam Traps

Advantages:

Excellent air handling capacity, can be used with super heated steam, removes condensate at saturation steam temperature and below.

Disadvantages:

Not freeze proof, susceptible to water hammer, high inventory requirements.

Thermostatic Steam Traps

The function of thermostatic steam traps is based upon the fact that steam contains more heat energy than condensate, the heat of the steam can be used to control the operation of the steam trap.

Two common thermostatic steam traps are:

Bimetallic Steam Trap

Bellows Steam Trap

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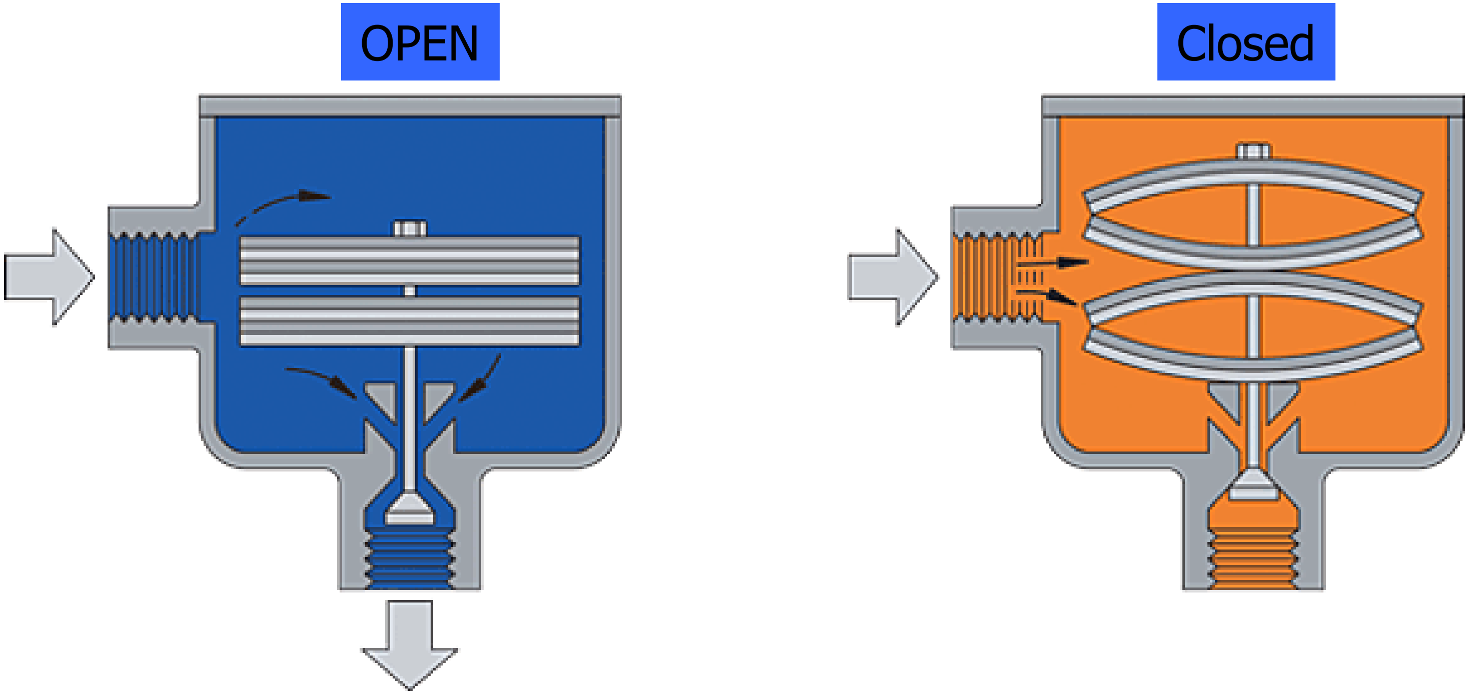
Bimetallic Steam Traps



Bimetallic Steam Traps

Advantages:

Can be used with super heated steam, removes condensate at saturation steam temperature and below.

Disadvantages:

Needs recalibration over time, Normally Fails-Closed.

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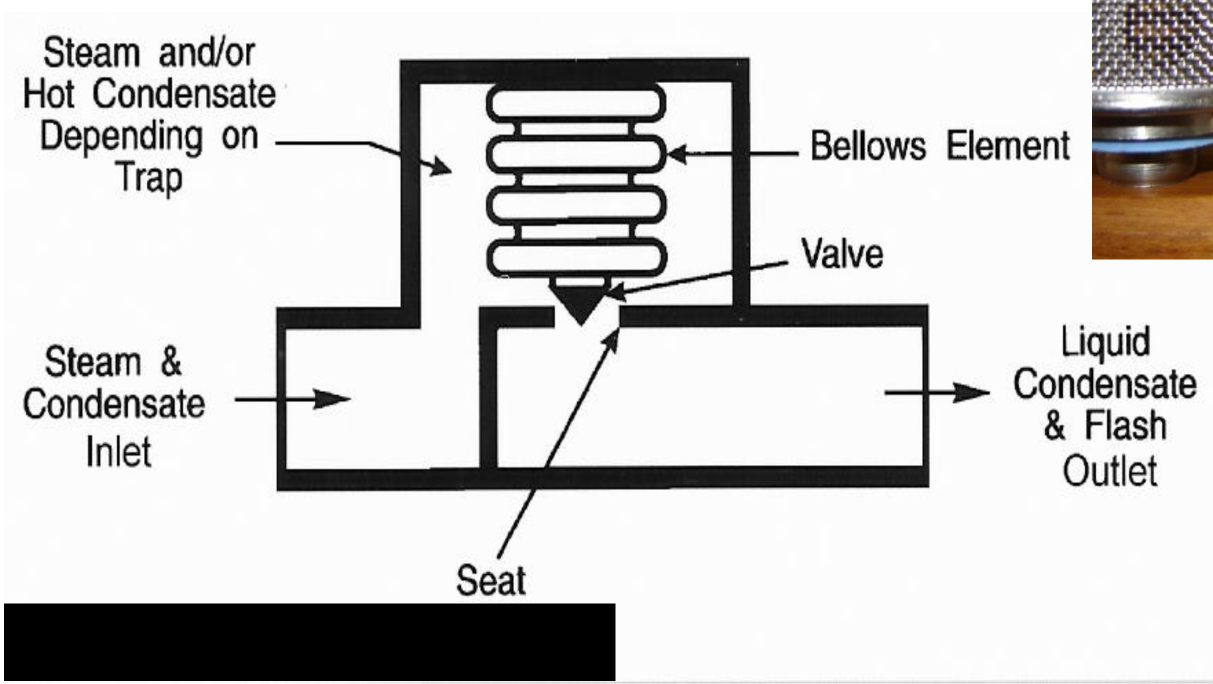
Bellows Steam Traps



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Bellows Steam Traps

Advantages:

Excellent air handling capacity. Water hammer resistant. Can be designed to Fail-Closed or Fail-Open. Automatically adjusts to variances in pressure.

Disadvantages:

Cannot be used on superheated applications or applications greater than 300 psig and 425 degrees Fahrenheit. Condensate must be sub-cooled before discharging.

Thermodynamic Steam Traps

The function of thermodynamic steam traps is based upon the fact that low density steam will exist above higher density condensate when both fluids are in a common container.

Two common thermodynamic steam traps are:

Disc Type Steam Trap

Orifice Type Steam Trap

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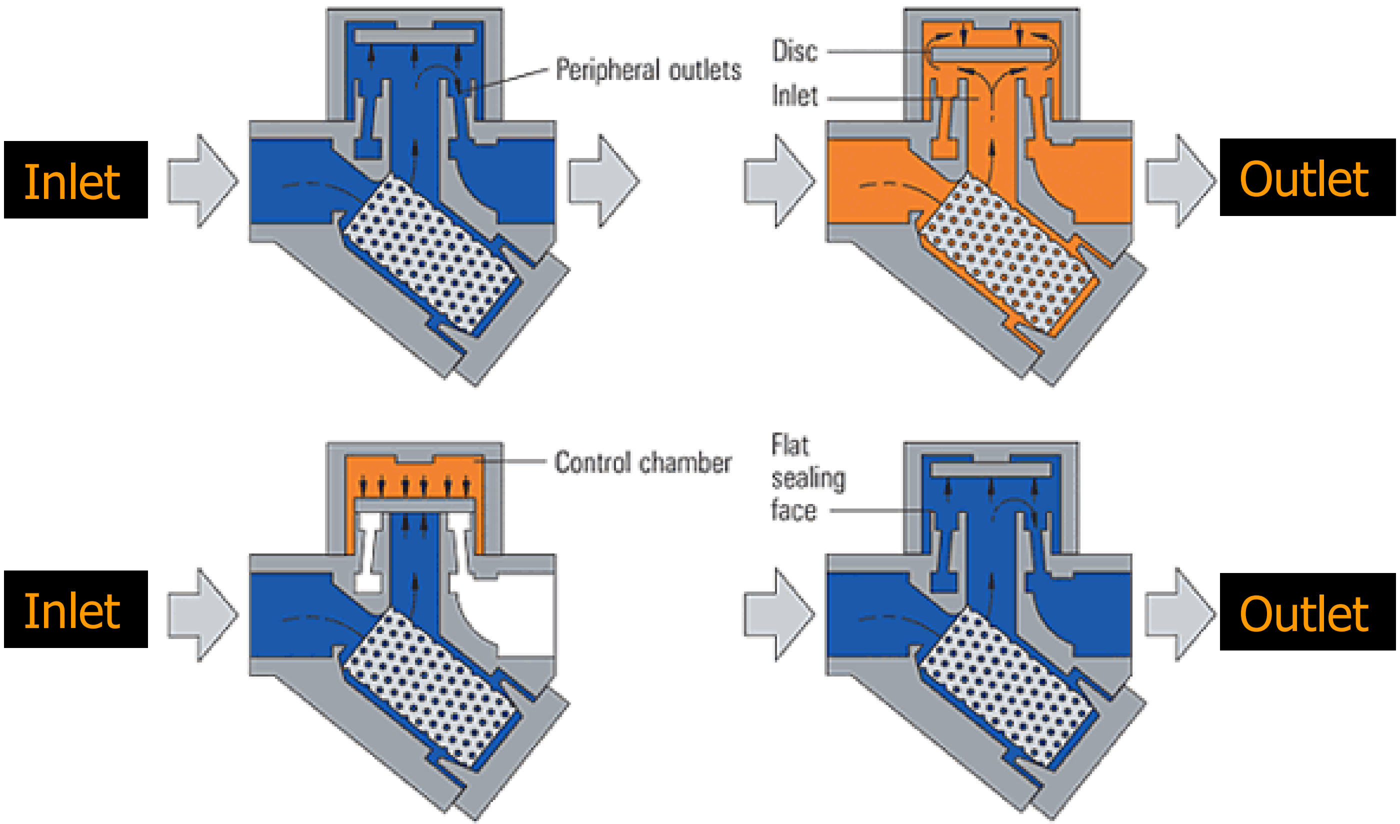
Disc Type Steam Traps



Disc Type Steam Traps

Advantages:

Rugged. Can be used on superheated and high pressure applications. Water hammer resistant. Normally Fails-Open. Freeze proof when mounted vertically.

Disadvantages:

Low Dirt Capacity. High back pressure (>50%) effects performance. Not recommended for pressures below

10 psig.

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Orifice Type Steam Traps

Not recommended for 99% of all typically seen applications. Try to avoid using. Replace when discovered. Waste vast amounts of energy. Very low tolerance to dirt.

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Steam Trap Surveys: Methods-Frequency

1 TRAP TAG# AND / OR TRAP LOCATION	2 SYSTEM PRESSURE PSI	3 MAKE AND MODEL	4 PMO	5 APPLICATION	6 TYPE OF TRAP	7 PIPE SIZE	8 CONNECTION TYPE	9 TEMP IN / OUT	10 LEGEND VALVES: O=OPEN X=CLOSED UNION: I|I =0 1 2 CTRL VLV: 0=NONE B=BEFORE A=AFTER	11 TEST RESULTS
				DL RT UH TR AHU HEX HUMID OTHER	IB FT BM TD 90°RT CAPS	1/2 3/4 1 1 1/4 1 1/2 2 2 1/4 2 1/2 3	NPT SW FL U OTHER:		BP IN ISO STR BD CHK TV OUT ISO I|I CTRL	F P P/NIA NIS
				DL RT UH TR AHU HEX HUMID OTHER	IB FT BM TD 90°RT CAPS	1/2 3/4 1 1 1/4 1 1/2 2 2 1/4 2 1/2 3	NPT SW FL U OTHER:		BP IN ISO STR BD CHK TV OUT ISO I|I CTRL	F P P/NIA NIS
				DL RT UH TR AHU HEX HUMID OTHER	IB FT BM TD 90°RT CAPS	1/2 3/4 1 1 1/4 1 1/2 2 2 1/4 2 1/2 3	NPT SW FL U OTHER:		BP IN ISO STR BD CHK TV OUT ISO I|I CTRL	F P P/NIA NIS
				DL RT UH TR AHU HEX HUMID OTHER	IB FT BM TD 90°RT CAPS	1/2 3/4 1 1 1/4 1 1/2 2 2 1/4 2 1/2 3	NPT SW FL U OTHER:		BP IN ISO STR BD CHK TV OUT ISO I|I CTRL	F P P/NIA NIS
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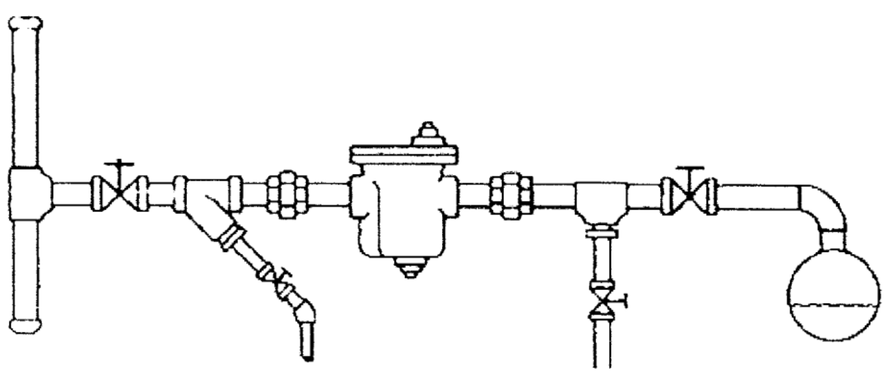
Methods of detection

Visual: Test Valve, observe discharge.

Sound: Using ultrasound probe.

Temperature: Using infrared gun.



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Steam Traps exist in a harsh environment!

Less than 5% of customers with steam maintain steam traps properly! Most traps have not been inspected for years, decades and sometimes never!

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Steam Traps exist in a harsh environment!

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Recommended Steam Trap Survey Frequency

0-30 psig: Every 12 months: 1X per year

30-100 psig: Every 6 months: 2X per year

100-250 psig: Every 4 months: 3X per year

>250 psig: Every 2 months: 6X per year

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Case Studies:

Marshall Middle School, Billerica MA ~ 131 Steam Traps

Cost to survey all traps = $2,700 (2 days @ $1,350/day)

127 Failed, 4 Passed

Cost to repair/replace 127 Steam Traps = $37,500 (average of $295/trap)

NGRID paid 100% of survey cost or $2,700

NGRID paid 50% of repair costs or $18,750

Total Cost of Project = $40,200

Cost to customer = $18,750

Estimated yearly savings = $28,442 (23,702 therms @ $1.20/therm)

Customers ROI after rebates = 0.70 years

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Case Studies:

Rhode Island School of Design, Providence, RI ~ 545 Steam Traps

Cost to survey all traps = $10,000 (8 days @ $1,250/day)

121 Failed, 424 Passed

Cost to repair/replace 121 Steam Traps = $47,000 (average of $388/trap)

NGRID paid 100% of survey cost or $10,000

NGRID paid 50% of repair costs or $23,500

NGRID paid an additional rebate (bundling incentive) of 30% (of the 50%) = $ 7,050

Total Cost of Project = $57,000

Cost to customer = $16,450

Estimated yearly savings = $54,098 (63,377 therms @ $0.854/therm)

Customers ROI after all rebates = 0.30 years

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Rules of thumb when conducting steam trap projects:

Steam Trap Survey Costs:

$1,350 to $1,500/day max.

A single technician can usually audit between 50 – 70 traps/day.

Steam Trap Repair Costs:

Radiator Steam Traps average $150 - $200, installed.

Mechanical Steam Traps average $300 - $1,000 installed.

Other Facts:

Standard Industry Steam Traps come with a one year warranty and last typically 3 to 7 years depending on service, environment, usage, etc.

Yearly Failure Rate: 10 -15% per year.

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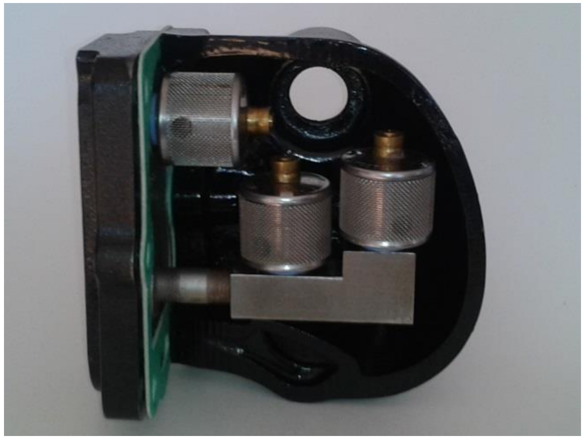
A new approach is discovered!

Use Steam Traps with built-in redundancy, built-in dirt accumulator, and a wide range of operating pressures to reduce inventory and human error when replacing!

Triple Trap, patented design



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For more information on Steam Traps, Surveys and other steam system information, please contact:

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To get started saving money and energy contact National Grid at:
800-787-1706 or Efficiency@nationalgrid.com