STEAM TRAP
CHECKING
Steam trap checking

- WHY WE NEED TO CHECK STEAM TRAPS
- METHODS OF CHECKING TRAPS
- ADVANTAGES AND DISADVANTAGES
- PRACTICAL DEMONSTRATION
Steam Traps Review

- Mechanical Traps
  - Float
  - Inverted bucket

- Thermodynamic

- Thermostatic
Float trap with thermostatic air vent
**Ball Float Trap Operation**

On start up, thermostatic air vent allows air to bypass main valve. Otherwise air could not escape and the trap would air bind.

Condensate reaches trap. Float raises and lever mechanism opens main valve. Hot condensate closes air vent. Condensate discharged at steam saturation temperature.

When steam arrives float drops and main valve closes. Main valve is always below water level, preventing leakage of live steam.
Inverted Bucket Trap
Inverted Bucket Trap Operation

Condensate reaches trap and forms a waterseal inside. The weight of the bucket keeps the valve off its seat. Condensate flows around bottom of bucket and out of the trap.

Steam enters the underside and the bucket rises. This raises the lever mechanism and the main valve ‘snaps’ shut.

The enclosed steam condenses and steam escapes through the vent hole. The weight of the bucket pulls the valve off its seat and the cycle repeats.

The vent hole in the bucket will bleed air into the top of the trap. The vent hole is small and will vent air slowly. A separate air vent may be required.
Balanced Pressure Thermostatic Trap
Balanced Pressure Thermostatic Trap Operation

1. On start up, cold air and condensate enter the trap and are freely discharged because the capsule is also cold and the valve is open.

2. As condensate approaches steam temp. capsule warms up. Liquid fill boils, causing vapour pressure, which acts on the diaphragms, to overcome the external pressure within the trap and pushes the valve towards its seat before steam is lost. Valve closes under dynamic effect of condensate flow and flow ceases.

3. The condensate cools. The vapour pressure in the capsule reduces and valve begins to open. Condensate is discharged and cycle continues.
Simple Bimetallic Trap
Bimetallic Plates
Bimetallic Trap Operation

On start up, the bimetallic element is relaxed, and the valve is open. Cooled condensate & air are discharged.

Hot condensate flowing through the trap heats the element, and it pulls the valve towards the seat.

As discharging condensate approaches steam saturation temperature, the element closes the valve. Condensate surrounds the element, which relaxes & upstream pressure opens the valve. The cycle repeats.
Operation of thermodynamic steam trap
On start up, incoming pressure acts on underside of disc, raising it and allowing air and cool condensate to be immediately discharged.

Simultaneously, flash steam pressure building up above the disc forces it to seat and close the inlet. The disc also seats on the outer ring, trapping pressure in the chamber.

When hot condensate flows up inlet passage into control chamber, it drops in pressure producing flash steam. The high velocity flash steam creates low pressure under the disc and pulls it towards its seat.

The pressure in the chamber lowers via condensing of the flash steam above the disc, normally caused by heat loss from the top cap. The disc is raised and the cycle repeats.
Discharge Temperatures of Steam Traps

Steam Saturation Curve

FT and IB
TD
BP
SM

Liquid expansion set at 60°C
TRAP FAILED CLOSED

- Plant will waterlog
- Reduced plant output
- Spoilt product
- Complaints of underheating
- Safety hazard - waterhammer
- Freezing

Easy to identify
TRAP FAILED OPEN

- Waste of energy/money
- Increases production costs
- Plumes of steam visible from vents
- Can cause problems in pipes
- Plant will still operate

Leaking traps can be difficult to identify
The consequences of steam leaks

From a 3mm orifice in a trap operating at 10 bar approx 25 kg/h of steam will be lost

Over a year of 8400 hours this represents a waste of 19,250 litres of fuel oil
Problems Caused by Leaking Traps

IF A TRAP FAILS OPEN
Wasted Steam = Wasted Fuel
If the orifice in the TRAP is...
3mm Diameter!
Pressure is 10 barg!
25kg/h wasted! = (210,000 kg/yr)

At least JD 13,000 Fuel (Oil)
Problems Caused by Leaking Traps

Energy Calcs....
Leaking Steam at 10 barg
With ø 3mm orifice leaks
25kg/h
Based on 24 hrs/day
7 days per week
50 weeks per year
(25x24x7x50)= 210,000 kg/yr
At least JD13,000 Fuel (Oil)
But how is this calculated?........
Problems Caused by Leaking Traps

Energy Calcs....
If condensate is returned at 90 °C
Steam generation pressure 10 barg
Energy cost in the leaking steam \((hg_{10 \text{ bar}}) = 2781.7 \text{ KJ/Kg}\)
If calorific value of fuel is 44,000 KJ/Kg
\(2781.7 / 44,000 = 0.063 \text{ kg net fuel/Kg of steam}\)
If Boiler efficiency = 80% then \(0.063/80% = 0.079 \text{ kg gross fuel/Kg steam}\)

DEN = MASS / VOL

VOL = \(0.0687 \text{ kg} / 0.86 \left( s_{\text{Den Oil}} \right) \)

VOL = 0.092 L of Fuel to raise 1 kg of steam@10 bar
∴ 1 kg of Steam uses 0.092 L Oil @ \(0.68 \text{ JD/L}\) = 0.0625 JD
∴ 210,000 kg Steam per year = 13137.6 JD per year (Fuel Oil)
Payback?

If cost of trap = JD 160
JD 160 Cost / JD 13000 Oil Saving/year

Payback
0.0123 Year = 1 week
Why do Steam Traps Fail?

Normal wear and tear

Carryover creates scale which can block the trap

Poor strainer maintenance - small trap orifices and parts can block or jam due to scale or rust.

Acidic condensate can cause corrosion

Waterhammer

Freezing

Incorrect sizing and selection

Incorrect installation

Inadequate maintenance
How can we locate traps which have failed open or closed?
Single and Double Window Sight Glass

Single window

Double window
Sight Check
Typical Installation

NB Fit at least 1 m downstream of blast action traps
Screwdriver
Stethoscope
Ultrasonic
Sensor Chamber

Flow

Indicator Connection
Sensor Chamber

- Flow
- Sensor
- Balance hole
- Condensate flows under the weir
Steam Trap Working Correctly

- Inlet
- Sensor Chamber
- Hole
- Weir
- Sensor submerged
- Condensate
Steam Trap Leaking Steam

- Inlet
- Sensor Chamber
- Sensor Exposed
- Hole
- Weir
- Condensate
Spiratec Steam Trap Monitoring System
Chamber or integral sensor options

Steam trap with separate sensor chamber

Steam trap with integral sensor

R1C automatic trap monitor

R16C automatic trap monitor

Type 30 hand held indicator
Hand-held Indicator
(Conductivity Only)

- Indicator cable plugs into sensor chamber or remote test point.
- Red light indicates trap passing live steam.
- Green light indicates trap passing no live steam.
Single and multi remote test points
(Conductivity Only)

Spiratec R1
Spirax Sarco Limited

Indicator cable connection
Automatic Multi Trap Monitor
(Conductivity and Temperature Sensor)

Red lights indicate trap leaking steam

Orange lights indicate trap blockage or waterlogging

Set point indicator

Red light: a trap problem

Green light: all traps working normally

Multi function programming buttons

R16C
The R16C can be installed on a cascade basis. One master box will monitor up to 16 x R16C boxes. A red light on the master box will indicate which local box is registering a faulty trap. The local box will identify the specific trap.
TO RECAP

- Open discharge - needs little experience, but condensate usually into closed system.
- Sight glass - Useful, needs experience but becomes obscure.
- Temperature - only shows failed closed.
- Sound - needs a lot of experience.
- Conductivity - simple red or green light, hand held indicator shows leaking traps only, electronic versions - single and multi monitors, shows failed open or closed.