INTERPLANT STANDARD - STEEL INDUSTRY		
IPSS	**SPECIFICATION FOR STEAM TRAP AND GUIDELINE FOR ITS SELECTION**	**IPSS:1-06-039-02**
	Corresponding IS does not exist	Formerly : IPSS:1-06-017-88 IPSS:1-06-021-86

0. FOREWORD

0.1 This Inter Plant Standard prepared by the Standards Committee on Pipes, Fittings, Valves and Piping Layout, IPSS 1:6 with the active participation of the representatives of all the steel plants and other agencies, established manufacturers of steam trap and was adopted in January 2002.

0.2 Inter Plant Standards for steel industry primarily aim at achieving rationalization and unification of parts and sub-assemblies used in steel plant equipment and accessories, and provide guidance in indenting stores or equipment for existing or new installations by individual steel plants. For exercising effective control on inventories, it is advisable to select a fewer number of sizes (or types) from among the products mentioned in this standard for the purpose of company standards of individual steel plants. It is not desirable to make deviations in technical requirements.

0.3 This Standard has been made by combining formerly of IPSS:1-06-017-88, IPSS:1-06-021-86, for convenience of user departments.

1. SCOPE

1.1 This Standard covers the requirement of steam trap selection, usage of steam traps for extracting the resultant condansate from the heat transfer system when steam is used.

2. TYPES – The steam traps shall be of following types:

a) Type A – Cast steel float trap (As shown in **Fig.1**)

b) Type B – Thermo dynamic steam trap (As shown in **Fig.2**)

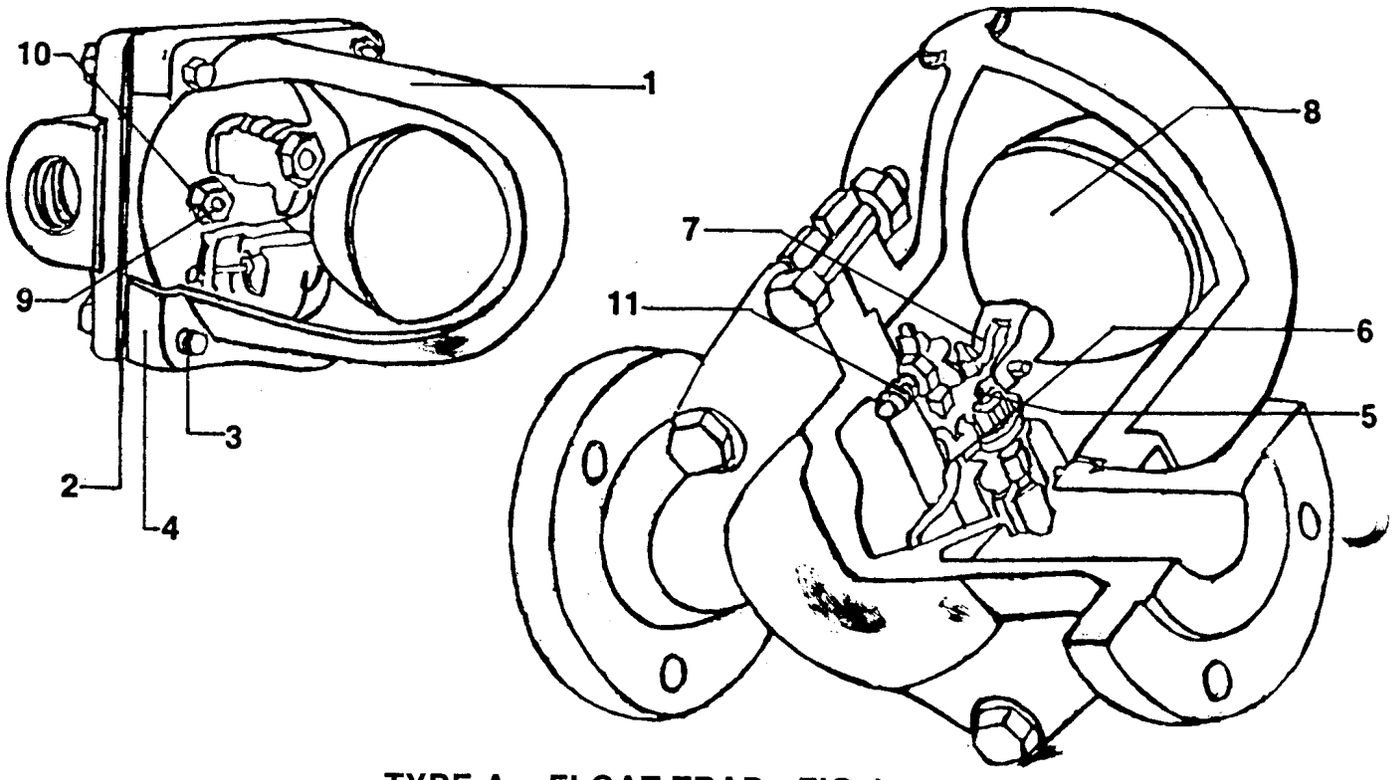
c) Type C – Thermo static balanced pressure type steam trap (As shown in **Fig.3**)

d) Type D – Inverted bucket type steam trap (As shown in **Fig.4**)

2.1 Since the traps are used in steam line application, each trap shall have IBR approval and shall be supplied with IBR test certificate.

3. MATERIAL

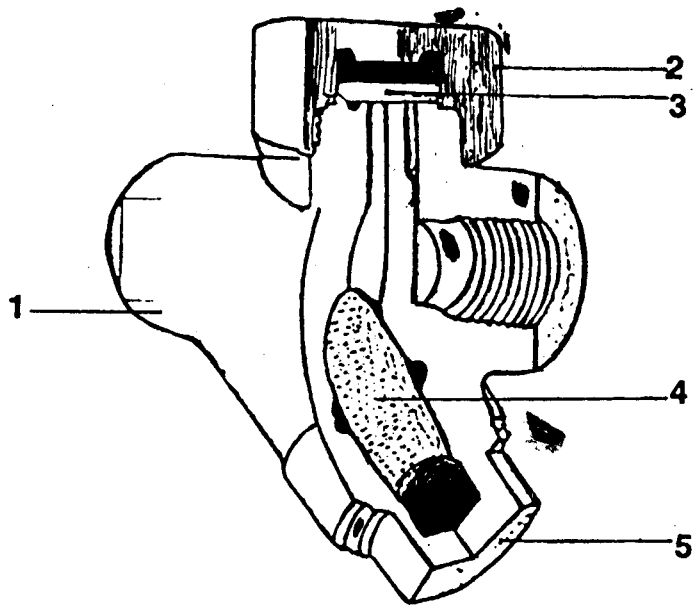
3.1 Material of construction for components of steam trap Type A :



TYPE A – FLOAT TRAP - FIG-1

Sl No.	Part	Material
1.	Body	Cast steel – ASTM A-105 or equivalent
2.	Cover gasket	Gaskets & packings compressed asbestos fibre jointing – IS 2712:1998 (third revision)
3.	Cover bolt and nuts	ASTM A-193, Gr-B7 & ASTM A-194 Gr 2H
4.	Cover	Cast steel – ASTM A-105 or equivalent
5.	Valve seat	Stainless steel (SS)AISI 420 or equivalent
6.	Valve seat gasket	SS AISI 420 or equivalent
7.	Pivot frame assembly set screw	SS AISI 420 or equivalent
8.	Bail float and lever	SS AISI 420 or equivalent
9.	Air vent	SS AISI 420 or equivalent
10.	Air vent seal gasket	SS AISI 420 or equivalent
11.	Steam lock release (SLR) unit	SS AISI 420 or equivalent
12.	SLR unit gasket	SS AISI 420 or equivalent
13.	SLR seat	SS AISI 420 or equivalent
14.	SLR seat gasket	SS AISI 420 or equivalent
15.	Support frame	SS AISI 420 or equivalent
16.	Pivot frame	SS AISI 420 or equivalent

3.2 Material of construction for component of steam trap, Type-B

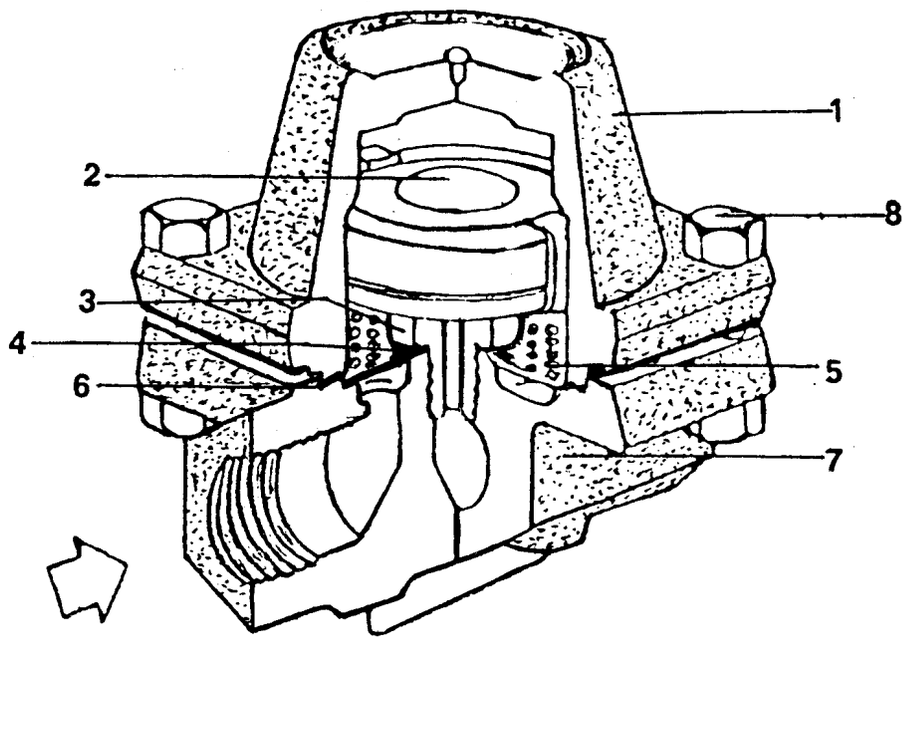


TYPE – B – THERMO DYNAMIC STEAM TRAP FIG-2

Sl No.	Part	Material
1.	Body	SS AISI 420 or equivalent
2.	Cap	SS AISI 420 or equivalent
3.	Disc	SS AISI 420 hardened to 40/45 RC or equivalent
4.	Strainer screen	SS AISI 304 or equivalent
5.	Seat/stainer cap	SS AISI 420 hardened to 40/45 RC or equivalent

NOTE: Recommended upto NB 200 steam pipe.

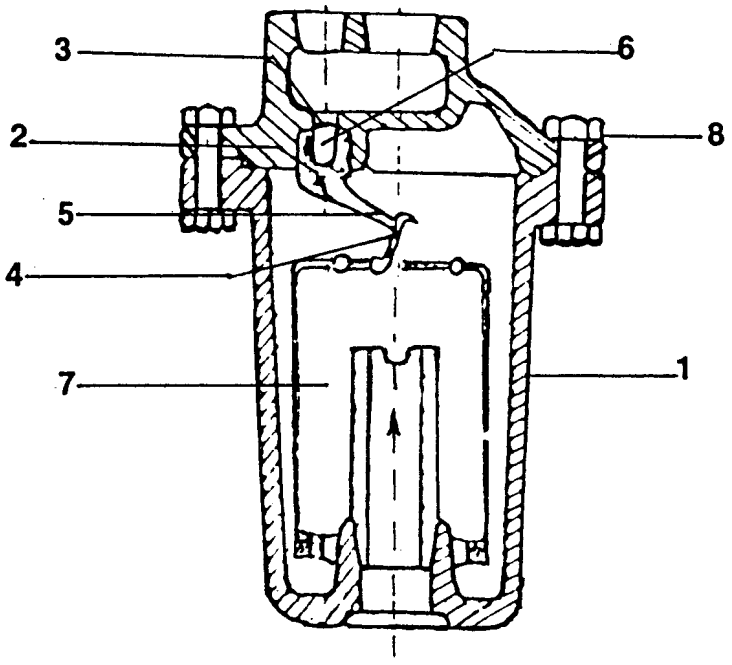
3.3 Material of construction for component of steam trap, Type-C



TYPE C - THRMOSTATIC BALANCED PRESSURE TYPE STEAM TRAP
Fig-3.

Sl No.	Part	Material
1.	Cover	Carbon steel ASTM A105 or equivalent
2.	Element/capsule	SS AISI 420 or equivalent
3.	Valve & seat assembly	SS AISI 420 or equivalent
4.	Valve seat gasket	SS AISI 420 or equivalent
5.	Strainer screen	SS AISI 304 or equivalent
6.	Cover gasket	Gasket and packings compressed asbestos fibre jointing, IS 2712:1998 (third revision)
7.	Body	Carbon steel ASTM A105 or equivalent
8.	Cover bolts & nuts	ASTM A-193, Gr-B7 & ASTM A-194 Gr 2H

3.4 Material of construction for component of steam traps, Type-D



`TYPE D' INVERTED BUCKET TYPE STEAM TRAP
Fig-4.

Sl No.	Part	Material
1.	Body & Cover	Cast steel ASTM A216 or WCB
2.	Valve	AISI 440 B
3.	Valve seat	AISI 440 B
4.	Valve retainer	AISI 304
5.	Valve lever	AISI 304
6.	Guide pin	AISI 304
7.	Bucket	AISI 304
8.	Bolts & nuts	Steel (High tensile)

Note: Recommended for NB 250 & above steam pipe.

4. DISCHARGE CAPACITY OF STEAM TRAP OF DIFFERENT TYPES

4.1 Discharge capacities of steam traps of different types are shown in Table-1, 2, 3 & 4 and Chart No. 1 & 2.

Table – 1 : Discharge capacities of steam trap, Type A

Differential pressure (kg / $cm^{2)}$	Condensate (kg/hr)	
	Size (NB 15, NB 20, NB 25)	Size (NB 40, NB 50)
0.8	100	1500
1	120	2000
2	200	2500
3	300	3000
4	400	3500
5	600	4000
6	700	4500
10	800	5000
14	1200	6000
18	1400	8000

Table – 2 : Discharge capacity of steam trap, Type-B

Differential pressure (kg / $cm^{2)}$	Condensate (kg/hr)	
	Size (NB 15)	Size (NB 20) / Size (NB 25)
10	180	500
20	250	700
30	260	800
40	270	900
50	290	1000

Table – 3 : Discharge capacity of steam trap, Type-C

Differential pressure (kg / $cm^{2)}$	Condensate (kg/hr)	
	Size (NB 15)	Size (NB 20)
1	300	500
2	400	600
3	500	700
4	600	800
5	700	900
6	800	1000
8	1000	1200
10	1200	1500
20	1800	2000

Table – 4 : Discharge capacity of steam trap, Type-D

Differential pressure (kg / $cm^{2)}$	Condensate (kg/hr)		
	Size (NB 15)	Size (NB 20)	Size (NB 25)
1	350	500	700
2	350	500	710
3	360	525	720
4	360	550	740
5	360	550	750
6	375	575	760
7	375	575	780
8	380	600	800
10	390	600	850
12	400	625	900
14	450	625	980
17	450	640	1000
20	500	640	1050
25	560	650	1100

NOTE: Figures for all Tables-1 to 4 are for guidance only, they vary from manufacturer to manufacturer and model to model. For actual details, consult – manufacturers catalogue.

5. TECHNICAL REQUIREMENTS

5.1 Special requirements for steam traps, Type A

a) Traps shall be preferably provided with inbuilt strainers;
b) Traps shall have high air venting capacity through auxiliary balanced pressure air-vent, which is self adjusting for varying steam pressure;
c) Traps shall have high thermal efficiency at both light and heavy loads;
d) End connections shall be screwed B.S.P.T or socket welded ends or flanged ends;
e) Continuous modulating discharge should not create pressure disturbances;
f) Traps shall have steam lock release facility;
g) Traps should have fair resistance to pulsating loads, water hammer and vibrations;
h) Traps shall have blast discharge and clean cut off;
i) Traps should be unaffected by change in inlet pressure fluctuations;
j) Traps should discharge condensate as soon as it form.

5.2 Special requirements for steam traps, Type B

a) Condensate entry below the disc should be concentric disc/seat to ensure parallel lift of the disc;
b) Traps should discharge condensate as soon as it forms;
c) Traps shall have high thermal efficiency at both light and heavy loads;
d) End connections shall be screwed B.S.P.T or socket welded ends or flanged ends;
e) Traps should have fair resistance to pulsating loads, water hammer and vibrations;

5.3 Special requirements for steam traps, Type C

a) The traps shall have discharge capacities to handle high starting lead and low running load;
b) The traps shall be able to take wide or sudden pressure fluctuation;
c) End connections shall be screwed B.S.P.T or socket welded ends or flanged ends;
d) Traps shall have high air venting and draining capacity at start up;

5.4 Special requirements for steam traps, Type D

a) The traps shall have sharp decisive on-off action of the valve which helps purging;
b) The traps shall have automatic air & CO_2 venting;
c) The traps shall withstand water hammer;
d) End connections shall be screwed B.S.P.T or socket welded ends or flanged ends;
e) The traps shall be primed properly;
f) The traps should take care of variable condensate rate and variable pressure condition;
g) The traps shall have in-built check valve for
    i) Pulsating loads;
    ii) Lifting condensate;
    iii) Elevated traps;
    iv) Superheated traps.

6. HYDROSTATIC TEST

6.1 Hydrostatic test pressure for body shall be as per IBR Test Certificate.

7. SELECTION OF STEAM TRAP

7.1 **Introduction** : Every intending user of steam traps, must ascertain the overall conditions under which a trap is to operate. After these conditions have been determined, however, the individual characteristics of the various types of steam trap must be considered in order to select the most suitable trap for a particular application.

7.2 **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. In a dition, for overall efficiency and economy, the trap must also provide :

a) Minimal steam loss;
b) 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.
c) Corrosion resistance – working trap parts should be corrosion resistant in order to combat the damaging effects of acid or oxygen-laden condensate;
d) 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;
e) CO_2 venting - Venting CO_2 at steam temperature will prevent the formation of carbonic acid. Therefore, the steam trap must function at or near steam temperature since CO_2 dissolves in condensate which has cooled below steam temperature;

f) Operation against back pressure – Pressurised return lines can occur both by design and unintentionally. A steam trap should be able to operate against the actual back pressure in its return system;

g) 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, and solids may carry over from the boiler. Even particles passing through strainer screens are erosive and, therefore, the steam traps must be able to operate in the presence of dirt.

A trap delivering anything less than all these desirable operating / design features will reduce the efficiency of the system and increase costs. When a trap delivers all these features the system can achieve :

i) Fast heat-up of heat transfer equipment;
ii) Maximum equipment temperature for enhanced steam heat transfer;
iii) Maximum equipment capacity;
iv) Maximum fuel economy;
v) Reduced labour per unit of output;
vi) Minimum maintenance and a long trouble free service life.

Sometimes an application may demand a trap without these design features, but in the vast majority of applications the trap which meets all the requirements will deliver the best results.

8. INFORMATION REQUIRED FOR SELECTION AND SIZING OF STEAM TRAPS

a) Maximum, minimum and normal steam pressures at the drain point;
b) Maximum rate of condensation or data from which this can be computed.
c) The extent of back pressure or vacuum, if either, on the outlet side of the trap.
d) Whether the duty is intermittent or continuous.
e) Some idea of the nature of the unit drained e.g. steam mains, coils; cylinders, driers, etc.
f) Whether the trap can be installed below the drain point or not.
g) Any information with regard to pulsations or sudden pressure fluctuations.
h) Temperature of steam and whether superheated.
i) If condensate is to be lifted, state height.
j) End connection type and size.
k) Type of trap.
l) Differential pressure.
m) Requirement of IBR certificate.

9. RECOMMENDED TEMPERATURE AND PRESSURE RATINGS FOR STEAM TRAPS

SL. NO.	TYPE OF STEAM TRAP	STEAM PRESSURE	TEMPERATURE
1	Type A	14 kg / cm^2	Upto 200°C
2	Type B	Upto 60 kg / cm^2	Upto 450°C
3	Type C	25-30 kg / cm^2	Upto 350 - 450°C
4	Type D	Upto 60 kg / cm^2	Upto 450°C

NOTE : This is for guidance only. It varies from manufacturer to manufacturer and from model to model).

10. RECOMMENDED SAFETY FOR STEAM TRAPS

SL. NO.	TYPE OF STEAM TRAP	FACTOR SAFETY
1	Type A	2 – 4
2	Type B	1.2 – 2
3	Type C	2 – 4
4	Type D	2 –3

The actual factor safety to be used for any particular application will depend upon the accuracy of :

a) Estimated load.
b) Estimated pressure at trap.
c) Estimated back pressure.
d) Any unusual / abnormal condition.

11. EFFECT OF BACK PRESSURE

11.1 In many installations, the piping from the outlet of the trap is connected to a common return system which may contain some pressure. The trap will have to operate against this pressure plus any static head created if the trap is required to leave the condensate to an overhead return. The total back pressure will reduce the capacity by the amount as given below :

Effect of back pressure on steam trap capacity in terms of % reduction in capacity

Back pressure as % of inlet pressure	Inlet pressure kg / cm^2			
	0.35	1.7	7.0	14.0
25	6	3	0	0
50	20	12	10	5
75	38	30	28	23

12. CALCULATING CONDENSATE LOADS

A) Steam pipe line (Radiation condensate load)

KGS. CONDENSATE PER HR. OF 30 MTR. OF INSULATED STEAM MAIN AT 21°C AMBIENT						
Steam pressure kg/cm^2	MAIN SIZES					
	NB 50	NB 80	NB 100	NB 150	NB 200	NB 250
0.7	3	4	5	8	10	12
4	5	7	9	14	17	21
7	6	9	11	16	20	25
20	10	15	19	28	35	44
42	15	22	38	41	52	64
NOTE : All figures in table assume the insulation to be 75% effective.						

B) Steam tracing lines (Radiation condensate load) - Approximately 30 kgs. Per hr/ of condensate for each 30 mtr. of spacer.

NOTE : Data given in (A) & (B) above are approximate and for guidance only. Actual load should be calculated.

C) Following is the general formula for radiation condensate load in steam pipes :

$$C_R = \frac{A \times U \times (t1-t2) \times E}{H}$$

Where C_R = condensate in KG per Hr. Mtr.
A = External area of pipe in M^2
U = Overall heat transfer co-officient, Kcal / M^2 x Hr °C
t1 = Steam temperature in °C
t2 = Air temperature in °C
E = 1 minus efficiency of insulation (example 75% efficient insulation means 1-0.75 = 0.25 i.e. E = 0.25)
H = Latent heat of steam Kcal/kg

D) General Usage formula

1) Heating water with steam
Kg condensate / Hr = LPH / 500 x temperature rise °C

2) Heating fuel oil with steam
Kg condensate / Hr = LPH / 1000 x temperature rise °C

3) Heating air with steam coils
Kg condensate / Hr = NM^3/Min x temperature rise °C / 27

E) Warming up load for steam pipeline

The warming up load can be calculated using the following formula :

$Cw = W \times (t1-t2) \times 0.114 / H \times t$

Where

Cw = amount of kg condensate per hr.
W = total weight of pipe in kg
t1 = final temperature in degree C
t2 = initial temperature of pipe in degree C]
0.114 = specific heat of steel pipe
H = latent heat of steam at final temperature in Kcal per KG.
t = Time of warming up of pipeline in hr.

F) Total condensate load for sizing of trap on steam pipeline –

Total condensate load (C) for steam pipelines drainage may be considered as

$C=C_W+1/2 \times C_R$

Total condensate load for trap sizing = C x (S.F) kg/hr

Where S.F = Safety factor (usually = 3)

NOTE : The warm up condensate load (Cw) decreases as radiation condensate load (C_R) increases. The peak occuring at about mid-day. For this reason, one half of radiation condensate load is considered and added to the warm up condensate load to obtain total condensate load.

13. LIFTING CONDENSATE

13.1 For application with submerged heating coils and mains, or existing elevated return lines, condensate can be lifted by keeping the following in mind.

- No trap lifts condensate, the available inlet pressure does. A pressure of one bar will support a column of water of 10 mts. high but to allow for pipe friction and system pressure drop, the vertical lift should be limited to 9 mts for every one KG/cm^2 pressure at the trap outlet. For low steam pressure below one KG/cm^2 pressure condensate elevation can cause water hammer damage. Use mechanical traps with low pressure and thermo dynamic disc traps with high pressure.

- Control valve operated equipment will have a variable trap inlet pressure. These applications require a float and thermo static trap with a check valve before the elevation to prevent back flow.

- For a lifting condensate to a trap, a U tube water seat and symphon pipe are necessary. The trap must be located after the top of the lift.

14. PRESSURE DIFFERENTIAL

14.1 Pressure differential is the difference between minimum steam inlet pressure and maximum condensate outlet pressure (or, condensate return-pressure if there is condensate return system). The trap must be able to operate against the pressure differential.

14.2 Because of flashing condensate in the return lines, a decrease in pressure differential due to static read (vent elevating) should not be considered.

15. FACTORS AFFECTING PRESSURE DIFFERENTIAL

15.1 Except for failure of pressure control valve, differential pressure usually varies on the low side of the normal or design value. Variations in either the inlet or discharge pressure can cause this.

Inlet pressure can be reduced below its normal value by :

a) A modulating control valve or temperature regulator
b) "Symphon drainage" Every 0.6096 mtr. of lift between the drainage point and the trap reduces the inlet pressure (and the differential) by .0703 KG/cm^2

Discharge pressure faced by the trap can be increased above its normal value by :

a) Pipe friction
b) Other trap discharge into a return system of limited capacity
c) Elevating condensate every 0.6096 mtr of lift increases the discharge pressure (and the differential) by .0703 KG/cm^2 where discharge is only condensate. However, with flash present, the extra back pressure would be reduced to zero.

16. HOW VARIOUS TYPES OF TRAPS NEED SPECIFIC OPERATING REQUIREMENT

CHARACTERISTIC	INVERTED BUCKET	FLOAT TRAP	THERMO DYNAMIC	THERMO STATIC
Method of operation	Intermittent	Continuous	Intermittent	Intermittent
Steam loss	No	No	Some	No
Registance to wear	Excellent	Good	Fair	Good
Corrosion resistance	Excellent	Good	Excellent	Excellent
Resistance to hydraulic shock	Excellent	Poor	Excellent	Poor
Vent air and CO_2 at steam temperature	Yes	No	No	No
Ability to handle start-up loads	Fair	Excellent	Poor	Excellent
Operation against back pressure	Excellent	Excellent	Poor	Excellent
Ability to purge system	Excellent	Fair	Excellent	Good
Ability to operate on very light loads	Good	Excellent	Good	Excellent
Responsiveness to surge of condensate	Immediate	Immediate	Delayed	Delayed
Ability to handle dirt	Excellent	Poor	Poor	Fair

Reference :

1. Reference - IS:12268:1995

2. The calculation procedure as per "Standard Handbook of Engineering" catalogue (third edition) by Tylor G Hicks, Page 3.403 and 3.404.