KLM Technology Group
#03-12 Block Aronia,
Jalan Sri Perkasa 2
Taman Tampoi Utama
81200 Johor Bahru
Malaysia

PROCESS DESIGN OF STEAM TRAPS

(PROJECT STANDARDS AND SPECIFICATIONS)

TABLE OF CONTENT

SCOPE	2
REFERENCES	2
SYMBOLS AND ABBREVIATIONS	2
UNITS	3
GENERAL	3
Types of Traps	3
Operating Characteristics and Suggested Applications	3
DESIGN CRITERIA	5
Application Definition	5
Steam Trap Selection	6
Steam Trap Sizing	7
COMMON PROBLEMS OF STEAM TRAPS	10
Freezing	10
Air Binding	11
Noise	11
Steam Leakage	11
Insufficient Pressure Difference	11
Dirt	12
Maintenance	12
PROPER STEAM TRAP INSTALLATION	13
APPENDIX A	16
APPENDIX B	17
APPENDIX C	18
APPENDIX D	19

SCOPE

This Project Standards and Specifications is intended to cover minimum requirements and guidelines for process engineers to specify proper type and prepare data sheet for steam traps. It contains basic reference information, data and criteria for steam trap selection as mentioned above.

REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

1. ANSI (American National Standards Institute) / ASME (American Society of Mechanical Engineers)

   PTC 39.1, "Performance Test Codes for Condensate Removal Devices for Steam Systems"

2. ANSI (American National Standards Institute) / FCI (Fluid Controls Institute)

   69-1, "Pressure Rating Standards for Steam Traps"

   85-1, "Standards for Production and Performance Tests for Steam Traps"

SYMBOLS AND ABBREVIATIONS

SYMBOL/ABBREVIATION	DESCRIPTION
BP	Balanced Pressure
BM	Bimetal
DN	Diameter Nominal, (mm)
FCI	Fluid Controls Institute
F&T	Float and Thermostatic
IB	Inverted Bucket
NPS	Nominal Pipe Size, in (inch)
TD	Thermodynamic
TS	Thermostatic

UNITS

This Standard is based on International System of Units (SI) except where otherwise specified.

GENERAL

Types of Traps

Most steam traps used in the chemical process industries fall into one of three basic categories:

- Mechanical traps, which use the density difference between steam and condensate to detect the presence of condensate. This category includes float-and-thermostatic traps and inverted bucket traps.
- Thermostatic traps, which operate on the principle that saturated process steam is hotter than either its condensate or steam mixed with condensible gas. When separated from steam, condensate cools to below the steam temperature. A thermostatic trap opens its valve to discharge condensate when it detects this lower temperature. This category of trap includes balanced pressure and bimetal traps as well as wax or liquid expansion thermostatic traps.
- Thermodynamic traps, which use velocity and pressure of flash steam to operate the condensate discharge valve.

Operating Characteristics and Suggested Applications

The key to trap selection is understanding the application requirements and the characteristics of the steam and knowing which traps meet those requirements while handling the steam condensate. Table 1 summarizes the operating characteristics and suggested applications for each type of trap.

Table 1 - Comparison Table to be Used to Identify Which Steam Trap to Consider for a Particular Application

TYPE OF STEAM TRAP	KEY ADVANTAGES	SIGNIFICANT DISADVANTAGES	FREQUENTLY RECOMMENDED SERVICES
Float-and thermostatic (F&T)	Continuous condensate discharge Handlesrapid pressure changes High noncondensible capacity	Float can be damaged by water hammer Level or condensate in chamber can freeze, damaging float and body Some thermostatic air vent designs are susceptible to corrosion	Heat exchangers with high and variable heat-transfer rates When a condensate pump is required Batch processes that require frequent start-up of an air -filled system
Inverted bucket (IB)	Rugged Tolerates water hammer without damage	Discharges non-condensibles slowly (additional air vent often required) Level of condensate can freeze, damaging the trap body (some models can handle some freezing g) Must have water seal to operate, subject to losing prime Pressure fluctuations and superheated steam can cause loss of water seal (can be prevented with a check valve)	Continuous operation where noncondensible venting is not critical and-rugged construction is important
Wax or liquid expansion termostatic (TS)	Utilizes sensible heat of condensate Allows discharge of non- condensibles at start-up to the set point temperature Not affected by superheated steam, water hammer, or vibration Resists freezing	Element subject to corrosion damage Condensate backs up into the drain line and/or process	Ideal for tracing used for freeze protection Freeze-protection, water and con-densate lines and traps Noncritical temperature control of heated Tanks
Balanced pressure thermostatic (BP)	Small and light-mass Maximum discharge of noncondensible start up Unlikely to freeze	Some types damaged by water hammer, corrosion and superheated steam Condensate backs up into the drain line and/or process	Batch processes requiring rapid discharge of noncondensibles at start-up (when used for air vent) Drip-legs on steam mains and tracing Installations subject to ambient conditions below freezing
Bimetal thermostatic (BM)	Small and light-mass Maximum discharge of noncondensibles at start-up Unlikely to freeze, unlikely to be damaged if it does freeze Rugged, withstands corrosion, water hammer, high pressure and superheated steam	Responds slowly to load and pressure changes More condensate back-up than BP trap Back-pressure changes operating characteristics	Drip legs on constant – pressure steam mains Installations subject to ambient conditions blew freezing.
Thermodynamic (TD)	Rugged, withstands corrosion, water hammer, high pressure and superheated steam Handles wide pressure range compact and simple Audible operation warns when repair is Needed	Poor operation with very low-pressure steam or high back-pressure Requires slow pressure build-up to remove air at start-up to prevent air binding Noisy operation	Steam mains drips, tracers Constant-pressure, constant-load applications Installations subject to ambient conditions below freezing

DESIGN CRITERIA

Surveys have found that only 58% of all steam traps are functioning properly. Other studies have found that almost half of all failures were not due to normal wear, but were, in fact due to misapplication, undersizing, oversizing, or improper installation.

That is why it is essential to follow these three steps (in addition to proper steam trap installation, checking and trouble shooting and correct steam trap maintenance) for successful steam trapping:

1. Application definition
2. Steam trap selection
3. Steam trap sizing

Application Definition

Steam trap application fall into two categories:

a. Drip and tracer traps

   Drip traps drain condensate caused by natural heat loss that is formed in steam mains and steam driven equipment. If this condensate remained in the piping, water hammer, corrosion and damage to the piping, valving and equipment would occur. Tracer traps drain condensate from steam tracers, which is tubing or pipe strapped to a process pipeline, water line, or instrument to keep it warm. Winterization tracing protects against freezing, while process tracing maintains the temperature of process liquids. Both drip and tracer traps are for system "protection". The failure of these traps can cause severe and costly consequential damages.

b. Process traps

   Process application fall into four categories based on the type of equipment, with steam either heating a liquid indirectly, air or gas indirectly, a solid indirectly, or a solid directly. Table 2 provides examples of each type of process application.

Table 2 - Categories of Process Steam Trap Applications

TYPE OF HEATING EQUIPMENT	TYPICAL EXAMPLES OF EQUIPMENT BEING HEATED
1. Steam heats a liquid indirectly	Submerged surfaces (batch still, evaporator, fuel heater, shell and tube exchanger, tank coil, vat water heater)
2. Steam heats air indirectly	Jacketed vessel (pan, kettle, concentrator) lift or syphon drainage (tilting kettle, sulfur pit, submerged pipe or embossed coil, shipboard tank)
3. Steam heats a solid or slurry indirectly	Natural circulation (dry air: convector, pipe coil, moist air: blanket dryer, dry kiln, drying room). Forced circulation (air blast heating coil dry kiln, air dryer, pipe coil, process air heater, unit heater)
4. Steam heats a solid directly	Gravity drained (chest-type ironer, belt press, chamber dryer, hot plate, platen) Syphon drained (cylinder ironer, cylinder dryer, drum dryer, dry can, paper machine) Gravity drained (autoclave, reaction chamber retort, sterilizer)

Steam Trap Selection

After defining the application, the next step is to select the correct type of steam trap based on performance criteria such as design failure mode (open or closed), speed of response, air handling capability, ease of checking, environment high or low temperature), potential for water hammer in the system, range of pressure operation and the presence of superheat. With rare exception, a steam trap should always be selected for failopen service. Other criteria which are more feature-oriented include ease of maintenance, (see Appendix D) ease of installation (including flexibility of horizontal or vertical piping) and integral strainer and blowdown valve. Table 3 provides some selection guidance. Selected trap types are subject to Company's approval.