ENGINEERING STANDARD

FOR

PROCESS DESIGN OF HEAT TRACING

AND WINTERIZING

FIRST EDITION

JULY 2018

FOREWORD

The Iranian Petroleum Standards (IPS) reflect the views of the Iranian Ministry of Petroleum and are intended for use in the oil and gas production facilities, oil refineries, chemical and petrochemical plants, gas handling and processing installations and other such facilities.

IPS are based on internationally acceptable standards and include selections from the items stipulated in the referenced standards. They are also supplemented by additional requirements and/or modifications based on the experience acquired by the Iranian Petroleum Industry and the local market availability. The options which are not specified in the text of the standards are itemized in data sheet/s, so that, the user can select his appropriate preferences therein.

The IPS standards are therefore expected to be sufficiently flexible so that the users can adapt these standards to their requirements. However, they may not cover every requirement of each project. For such cases, an addendum to IPS Standard shall be prepared by the user which elaborates the particular requirements of the user. This addendum together with the relevant IPS shall form the job specification for the specific project or work.

The IPS is reviewed and up-dated approximately every five years. Each standards are subject to amendment or withdrawal, if required, thus the latest edition of IPS shall be applicable

The users of IPS are therefore requested to send their views and comments, including any addendum prepared for particular cases to the following address. These comments and recommendations will be reviewed by the relevant technical committee and in case of approval will be incorporated in the next revision of the standard.

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GENERAL DEFINITIONS

Throughout this Standard the following definitions shall apply.

COMPANY :

Refers to one of the related and/or affiliated companies of the Iranian Ministry of Petroleum such as National Iranian Oil Company, National Iranian Gas Company, National Petrochemical Company and National Iranian Oil Refinery And Distribution Company.

PURCHASER :

Means the “Company" where this standard is a part of direct purchaser order by the “Company”, and the “Contractor” where this Standard is a part of contract document.

VENDOR AND SUPPLIER:

Refers to firm or person who will supply and/or fabricate the equipment or material.

CONTRACTOR:

Refers to the persons, firm or company whose tender has been accepted by the company.

EXECUTOR :

Executor is the party which carries out all or part of construction and/or commissioning for the project.

INSPECTOR :

The Inspector referred to in this Standard is a person/persons or a body appointed in writing by the company for the inspection of fabrication and installation work.

SHALL:

Is used where a provision is mandatory.

SHOULD:

Is used where a provision is advisory only.

WILL:

Is normally used in connection with the action by the “Company” rather than by a contractor, supplier or vendor.

MAY:

Is used where a provision is completely discretionary.

CONTENTS: **PAGE No.**

0. INTRODUCTION

The primary purpose of IPS standard specifications on "Process Design of General Heating & Cooling and Flushing Systems" is to establish minimum requirements and design criteria needed in "Process Design" of the following standards:

STANDARD CODE	STANDARD TITLE
IPS-E-PR-400	"Process Design Cooling of Water Circuits"
IPS-E-PR-410	"Process Design of Hot Oil, & Tempered Water Circuits"
IPS-E-PR-420	"Process Design of Heat Tracing and Winterizing"

The specifications and basic practices covered under these standards are made in the light of available existing accumulated information and knowledge experienced and known to the Company at the time of writing, but it has been impossible to consider every possible factor that might affect process design on a particular point.

This Engineering Standard Specification covers:

"PROCESS DESIGN OF HEAT TRACING AND WINTERIZING"

1. SCOPE

This Standard Specification covers the minimum requirements for protection of process and utilities and all associated equipment and flow lines and instruments against the temperature which would cause congealing or freezing of contents, interfere with operation or cause damage to equipment or pipe lines and for heat conservation requirement as would be determined by process conditions. The heat conservation system shall be designed for continuous operations while, winterizing shall be for seasonal operation. The two systems shall be separated from each other.

Note:

This is a revised version of this standard, which is issued as revision (1)-2018. Revision (0)-1996 of the said standard specification is withdrawn.

2. 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.

IPS (IRANIAN PETROLEUM STANDARDS)

IPS-E-PR-230	"Engineering Standard for Piping & Instrumentation Diagrams (P&IDS)"
IPS-M-EL-190	"Material Standard for Electrical Heat Tracing"
IPS-C-TP-701	"Construction standard for application of Thermal Insulations"
IPS-E-TP-700	"Engineering Standard for Thermal Insulations"
IPS-E-PR-400	"Engineering Standard for Process Design Cooling of Water Circuits"
IPS-E-PR-410	"Engineering Standard for Process Design of Hot Oil, & Tempered Water Circuits"
IPS-E-PI-221	"Engineering Standard for Piping Material Selection"

API (AMERICAN PETROLEUM INSTITUTE)

API RP- 551, Section 10	"API Recommended Practice 551 "Process Measurement", SECOND EDITION, FEBRUARY 2016

3. DEFINITIONS AND TERMINOLOGY

Throughout this Standard words have specific meaning as described below:

3.1 Heat Tracing: The application of hot liquid, vapor or steam tracing tubes or electric heating cables or tapes to pipes, fittings, valves, pumps, tanks, instruments or instrument lines to offset the heat loss through thermal insulation.

3.2 Heat Loss: The rate at which heat flows from a hot surface such as a process pipe to a cooler atmosphere, usually stated in Btu/h•ft. (W/m) of pipe. Generally, the heat loss is from the pipe through the pipe insulation to the cooler atmosphere.

3.3 Winterization: winterization is the preparation of piping and equipment for operation in winter weather, including cold temperatures, high winds, snow and ice. Sometimes it is referred to as “freeze protection” or “warming services”

Steam Trap: Automatic device used to hold steam in a steam tracing circuit until it has given up its latent heat and allows condensate, air and other gases to pass while preventing the passage of steam.

4. SYMBOLS AND ABBREVIATIONS

CM = Collection Manifold

DM = Distribution Manifold

DN = Diameter Nominal (Pipe Size), in (mm)

ET = Electric Traced and Insulation

ETT = Electric Traced with Heat Transfer Cement

H = Heat Conservation

ID = Inside Diameter

MI = Mineral Insulation

TB =Trace body and insulate.

TBB =Trace body and bonnet and insulate.

PD Meters = Positive Displacement Meters

P & ID = Piping and Instrumentation Diagram

Ref = Reference

OD = Outside Diameter

SJ = Steam Jacketing Pipe and Insulation

ST = Steam Traced and Insulation

STS = Steam Traced with Spacers and Insulation

STT = Steam Traced with Heat Transfer Cement and insulation

UOP = Universal Oil Products

W = Winterization

WS = Winter Seal

WISI = Winterize Insulator, Steam Trace, Insulate

5. UNITS

This Standard is based on International System of Units (SI), as per IPS-E-GN-100 except where otherwise specified.

6. APPLICATION AND METHODS

6.1 General Considerations

To avoid operating difficulties in process and utility units in colder climates and the hazard of freezing which may cause damage to equipment or blockage of lines, different methods to the extent of protection required, will be used. The extent of protection may vary considerably between one location and another. However, the requirements for other ambient temperature conditions are also covered herein.

6.2 Methods of Winterization

The following methods of winterization are required to be used for adequate protection as will be determined by combined climatic and process condition for seasonal operation and heat conservation:

a) Insulation

The insulation alone (as per IPS-E-TP-700 & IPS-C-TP-701) may be used to prevent solidification or increase in viscosity where the liquid in the equipment has sufficient sensible heat for normal operating flow rates and will be of value only for short time exposure; for long term exposure however it is only successful when heat is continuously added by the process. Although heat input at normal flow rates may be adequate, it may fall to an unsatisfactory level at low throughputs, or during start up or shut down, or when a line is blocked off in error, and as a result, freezing of the system may take place.

b) Heating

Winterizing with heating should not be used where other methods can be used. Any of the following heating system may be used:

- Internal heat tracing
- External heat tracing
- Jacketing
- Electrical tracing
- Routing along and/or insulating together with a hot line.

Note:

Heating medium for non-electric tracing and jacketing can be steam, hot oil and hot water. The most common heating methods are electrical and steam tracing. The most common heating methods are electrical and steam tracing.

c) Vent / Drain on lines and equipment

Winterizing by draining require particular attention which must be given to vents and drains on utility lines and equipment for eliminating low spots or dead ends in which water and other liquids can collect and freeze. During shut-down and non-operating period these lines may completely be drained.

d) Bypasses around equipment to provide continuous flow

Bypass line connection in appropriate points as specified herein, and in accordance to project specification should be provided for use in maintaining flow.

e) Hot air circulation

Hot air circulation may be used in aerial exchangers, instrument and equipment housing, flushing connections to displace viscous-fluid.

7. CONDITIONS REQUIRING WINTERIZATION

7.1 Process, utilities, equipment and pipe lines and other equipment/pipe lines shall be winterized when any of the following conditions apply to fluids contained:

a) Pour point or freezing point is above the lowest ambient temperature.

b) Undesirable phase separation, deposition of crystals or hydrate formation will occur at any ambient temperature.

c) Ice or hydrate formation occurs due to pressure reduction of moisture-bearing gases.

d) Viscosity at any ambient temperature is so high that an inadequate flow rate is obtained with the pressure available for starting circulation.

e) Corrosive compounds form if condensation occurs.

f) Lines which are normally dry, e.g., flare lines which may carry moisture during an operating upset may require some protection.

8. REQUIREMENTS

8.1 General

8.1.1 The requirements for protection shall be based on the winterizing temperature specified in project specification, and shall consist of two parts:

a) Lines and equipment which appear on P & IDs. The extent and degree of protection shall be specified by the project engineer and shown on the P & IDs, by IPS-E-PR-230 Standard nomenclature.

Note:

Protection described by standard nomenclature on P & IDs may be inadequate for projects involving low winterizing temperatures in combination with unusual process fluid properties. On such projects consideration shall be given to the use of high thermal conduction cement bonding of tracers, steam jacketing, electric heating, shelters and other special design.

b) Lines and equipment not shown on the P & IDs. Protection shall be provided by the design Contractor/ Consultant to the extent and in the manner provided herein.

8.1.2 Layout, design and details which are to be followed by the design Contractor in winterizing all equipment shall be as specified herein.

8.1.3 Protective heating of piping and instruments shall be indicated on the process engineering flow schemes and on the piping data sheets.

8.1.4 The extreme case of the lowest minimum temperature should not be selected, but in general, equipment should be designed for protection against the minimum temperature prevailing after rejection of the lowest 1% of the hourly temperature readings in the coldest month, or in 1% of the daily minimum temperatures for the year; the readings should as far as possible be based on the average of records obtained over a period of years and not those of a single year.

8.1.5 The amount of winterizing protection shall be based on minimum atmospheric temperature as shown on site data sheet. For heat conservation during operation, fluids with a pour point of 10°C and higher shall be traced to maintain a temperature at least 22°C above their pour point. Molten sulfur lines shall be maintained between 118°C (245°F) and 158°C (316°F).

8.2 Piping

8.2.1. A list of all piping requiring tracing should be prepared for each Unit in project specification.

8.2.2 Sections of gas systems in which ice or condensate would otherwise be produced, due to atmospheric cooling or auto refrigeration, should be traced. Protection will also be required where there is hydrate formation at temperatures above 0°C.

8.2.3 Careful consideration should be given to the design and protection of lines which are dry during normal operations but which may contain sufficient moisture to be troublesome during an operational upset, e.g., flare lines, etc.

8.2.4 Process piping

8.2.4.1 Compressor suction lines between the knockout drum and the compressor shall be heat traced and insulated if ambient temperature is below the dew point of the gas at compressor suction or if handling hydrocarbon gas components heavier than ethane.

8.2.4.2 Intermittently used process piping containing liquids such as tars or chemicals, which will congeal during no flowing conditions, shall be provided with valves for venting and draining, blowing out with air or flushing with light stock in preference to heat tracing.

8.2.4.3 Tank car and tank truck loading lines shall be heat traced and insulated and provided with valved flushing or blow out connections.

Note:

Blowing out piping with air shall be confined to lines containing stocks of low volatility which are well below their flash points. Where piping to be blown discharges into tankage. Venting capacity shall be provided to prevent pressurizing the tankage.

8.2.5 Piping for water services

8.2.5.1 When daily mean temperature is below -1°C, underground water systems (including sewers) shall be installed at a minimum of 300 mm below the frost line. Above ground portion of water systems shall be winterized by such means as heat tracing or draining component, of the system after each use. All piping in salt water service, if heat traced, shall be cement-lined. A typical pipe line external tracing detail is shown here in Appendix B.

8.2.5.2 Where branch single service lines rises from below ground, block valves shall be provided in the risers just above the ground. The following arrangement will provide protection against freezing:

a) A by-pass shall be provided just under the block valves, from the supply back to the return for use in maintaining circulation. This by-pass shall be DN 20 (¾") for lines DN 80 (3") and smaller, DN 25 (1") for lines DN 100 (4") to DN 200 (8") and DN 40 (1½") for lines larger than DN 200 (8"). Bypasses shall be covered with 25 mm of insulation.

b) A drain shall be provided in the line at a minimum distance above the block valve, except that for 150 mm and larger size valves a drain shall be provided in the valve body above the seat.

c) 25 mm of insulation shall be provided around the piping, from the ground up to and including the block valves in the water risers.

8.2.5.3 Where a header for multiple services rises from below ground, protection shall be provided in the same manner as overhead headers.

8.3 Instruments

8.3.1. Winterization of instrumentation systems should be in accordance with Section 10 of API RP 551. However, when electronic instruments are heat traced the type of heat tracing should be to the instrument manufacturer's recommendation. Consideration should be given to the use of electrical heat tracing and also to thermostatic control to ensure the manufacturer's specified operating temperatures are not exceeded.

8.3.2 Proposals for winterization are to be discussed and agreed with the Company.

8.3.3 Where practical, instruments shall be installed in heated buildings to simplify protection requirements and facilitate maintenance.

8.3.4 Electronic instruments which may be damaged by freezing shall either be installed in heated housing or located in buildings to maintain the temperature within the manufacturer's recommended

temperature rating.

8.3.5 When installation of instruments in heated building is impractical, protection is required for instruments on water, steam, hydrocarbons or other liquid services which are subject to freezing or congealing. A safe temperature should be maintained for hydrocarbons with pour points -12°C and above.

Protection is also required on gas or air service where condensate may render instruments inaccurate operation or make inoperative and on liquid services where moisture is likely to enter lead lines and instruments.

8.3.6 Precaution shall be taken to prevent excessive heating of mechanical and electrical instrument components.

8.3.7 Enclosed analyzer cabinets shall be heated.

8.3.8 Preferred practices are insulation, heat tracing and heated instrument housing to maintain the manufacturer's recommended temperature rating.

8.3.9 Instrument piping shall be winterized by sealing with an antifreeze solution where possible. Protective heating of lead lines shall be installed in a manner which will prevent the liquid from overheating and boiling away.

8.3.10 It is not considered economical to provide a dedicated tracer for a pressure gauge. Rather, a pressure gauge is provided with a diaphragm seal and tightly coupled to the pipe and insulated. However, for corrosion protection, locally mounted pressure gages and instruments, and seals required, shall be winterized.

8.3.11 Unless otherwise specified by the manufacturer the following locally mounted instruments shall not be housed in cabinets. They are winterized by sealing, heat tracing, or by a combination of both:

1) Alarm pressure switches

2) Control pilots for control valves

3) Displacer type level instruments

4) Float-type alarm units

5) Pressure gauges.

8.3.12 Instrument housings

Insulated enclosures are used for instrument protection. It is recommended that manifold valves be included within the enclosure. Designs are available that enclose instrument valves, manifolds, and special piping configurations (e.g. purges).

There are three basic types of instrument enclosures:

- Soft enclosures;
- Full molded enclosures;
- Partial molded enclosures.

For more information and typical molded housings and their mountings refer to API RP551 section 10.6

8.3.13 Level instruments

a) Protective provisions for differential type level instruments conform to that, described for differential type flow instruments as in Clause 7.3.14.

b) External float instruments are heat-traced for the following services:

1) Steam

2) Water

3) Caustic

4) Viscous hydrocarbon with a pour-point -12°C and above

5) Light hydrocarbon where hydrate formation is possible.

8.3.14 Flow instruments

Differential pressure instruments having factory-filled bellows or diaphragm assemblies are specified with a fill material that does not require winterizing. Care should be taken not to overheat diaphragms above their design temperature.

Rotameters are winterized in accordance with the requirements of the process line in which they are installed. They are housed when they are recording and when they are outdoors.

8.3.15 Control valves

a) Control valves are not traced with the associated process piping, except that valves are steam traced on gas or vapor services with high pressure drops, where hydrates may be formed, or where freezing or congealing may occur.

b) When control valves used as direct connected regulators require winterizing, the pressure control line and valve diaphragm chamber containing the process fluid shall be heat traced and insulated. When the diaphragm chamber is sealed, the pressure control line shall be heat traced and insulated from the point of seal to the process line connection.

c) In light hydrocarbon-vapor services, where hydrate formation or frosting due to low temperature is likely, only the control valves body shall be heat-traced.

d) Steam atomizing control valves with diaphragm and in contact with heavy process fluid shall be protected with seal pot filled with glycerin.

8.3.16 Temperature instruments

Bulb type temperature instruments shall be specified with fill material which does not require winterizing for the particular zone in which they are to be installed.

8.3.17 Lead lines and instruments

a) Lead lines and instruments containing fluids subject to winterizing shall be protected by seals, tracing or heated housings.

d) In areas where steam or electricity is not readily available for heat tracing, consideration shall be given to use of instruments equipped with a mechanical diaphragm type seal at the process connection, in lieu of heat tracing.

e) Instruments with dry gas or dry air purging do not require protection for the lead line.

f) Instrument lines and gage glasses which are steam traced and contain liquids that boil at tracing steam temperature shall be separated from the tracer lines by insulation of 25 mm.

8.3.18 Barrier fluids and seal liquids

Liquid seals are used to protect the instrument from the effects of high temperatures, corrosive, or freezing conditions.

It is recommended that liquid seals be used only when necessary, since even the best of them get diluted with time or lost during process upsets. Measurement problems can occur when non-condensable gases become dissolved in the reference leg or sensing lines. Accumulated gases can

come out of solution during an abrupt depressurization, causing the fill to swell and come out of the reference leg or sensing line.

If a hydrocarbon stream contains water, the liquid in the impulse lines separates into two phases causing errors. For instance, with a differential pressure flow meter, different amounts of water could accumulate in the impulse lines producing a measurement error. To prevent this, the lines can be filled with an immiscible liquid. Ethylene-glycol and water mix also could be used, but errors eventually occur due to uneven dilution.

8.3.19 Seal liquid selection

Mercury was once considered an ideal seal liquid because of its high vapor pressure and high density. The use of Mercury is no longer allowed due to its health effects and its ability to cause liquid metal embrittlement. The ideal seal liquid has the following characteristics (Refer to API RP-551 for seal fluid selection):

a) Non-toxic and Iran FDA /HSE organization approved;

b) Specific gravity higher than vacuum column bottoms;

c) Non-flammable;

d) Inert particularly with olefin compounds and asphaltenes;

e) Insoluble with water and hydrocarbons;

f) Low vapor pressure at high temperatures;

g) Low viscosity;

h) Freezes below -40 °C (-40 °F);

i) Thermally stable at extreme temperatures;

j) Readily available.

No compound has every characteristic. However, some liquids have more advantages than others. Further, some of the customary liquids require reassessment.

8.3.19 Analyzing instruments

a) Sample system for analyzers which require a liquid stream shall be protected in the same manner as the pipe line from which the sample is obtained, using caution to insure the sample is not damaged by overheating or vaporizing.

b) Gas samples to analyzers which contain condensable shall be provided with heat tracing to prevent condensation.

c) Heated housing shall be provided for analyzer and with temperature control and sample conditioning systems. Each analyzer installation shall be investigated for winterizing requirements.

8.4 Valves

8.4.1 Where necessary, relief valves and adjoining piping should be suitably protected.

8.4.2 The vent line relief valves discharging to atmosphere should have a suitable drain hole at the lowest point.

8.4.3 Flanged shut off valves and check valves in vertical lines shall have bodies trapped and valved above the disk or seat if commodity will freeze or congeal during shutdown.

8.4.4 Water seals and traps should be steam traced.

8.4.5 Low points of flare lines should drain into vessels which are suitably protected against

freezing.

8.5 Equipment

8.5.1 Drum, vessel, storage tanks

8.5.1.1 A drum or vessel containing hydrocarbon and water which operate normally at 52°C or above, shall be protected by insulating the nozzles, block valves and drain piping in contact with water.

8.5.1.2 A drum or vessel containing hydrocarbon and water which operates normally below 52°C shall be protected by steam tracing and insulating the nozzles, block valves and drain piping in contact with water.

8.5.1.3 All other process vessels containing fluids which may congeal during dormant periods shall be insulated and if necessary shall be heat traced.

8.5.1.4 Bottoms of fuel gas drums and low points in above ground gas lines shall be insulated and steam traced.

8.5.1.5 Tanks containing liquids difficult to pump or flow when cold, shall be equipped with heaters.

8.5.1.6 Steam coils in tanks should consist of a number of sections arranged in parallel flow, thus avoiding the total loss of tank heating in the event of a coil section leaking.

8.5.1.7 Roofed or open water tanks (except for potable water tanks) shall have connections to heat and agitate water at intervals to prevent freezing.

8.5.1.8 Storage tanks shall be equipped with freeze proof type water draw valves.

8.5.1.9 Consideration may have to be given in some extreme cases to insulating the roofs of some cone roof tanks to prevent internal corrosion due to condensation of sulphurous vapors.

8.5.2 Exchangers

8.5.2.1 Heat exchangers and coolers containing liquids which may congeal or freeze at ambient temperature shall have sufficient valved drain points to insure complete drainage upon shutdown.

8.5.2.2 Evaporators in chlorine service shall be housed in a heated, forced ventilated buildingif the ambient temperature can drop below 13°C.

8.5.3 Pumps and compressors

8.5.3.1 Although compressors may be housed in enclosed or partly sheeted buildings, consideration should be given to the protection of any exposed parts such as water lines, lubricating and seal oil lines, air and oil filters, suction lines and knock-out drums. Tracing of the oil sumps of compressors may be required to assist start up.

8.5.3.2 Pumps shall have plugged drains on all water cooled jackets and pedestals.

8.5.3.3 Compressors and auxiliaries enclosed in buildings shall have winterizing protection when the system is shut down.

8.5.3.4 Heating shall be provided for every reciprocating pumps lubricator.

8.5.3.5 Pumps and associated piping shall be protected as required by the nature of fluids handled and duration of anticipated non-operating periods. Circulating fluid from an active pump through a non-operating pump is a preferred practice for pumps handling viscous fluids. (See Appendix C for typical steam tracing of pumps).

8.5.3.6 The pumps in intermittent services which cannot conveniently be drained whenever not in use, should be traced or jacketed or located in a heated enclosure if the liquid handled would otherwise freeze or become too viscose to pump.

8.5.3.7 Seal and flushing oil piping shall be steam traced whenever cooling to the ambient temperature would diminish the quantity or pressure of seal oil at the point of consumption below the equipment manufacturer's recommended minimum.

8.5.3.8 Suitable provision should be made in the water systems of equipment which is on intermittent duty or immediate standby duty and which cannot therefore be drained to ensure that it will not freeze during idle periods. A particular case to be checked is that of machines which have thermostatic valves for controlling water flow which may cut off the water completely during idle periods.

8.5.3.9 Pumps handling fluids with a pour point above 10°C shall meet the following Heat Conservation requirements: Pumps are not to be traced(except asphalt and high viscosity fluids pumps which shall be jacketted) All piping including dead legs shall be heat traced and insulated to maintain the fluid temperature at least 22°C above pour point. Back-flow circulation should be used through non-operating pumps. Flushing oil should be used to clear the systems, and the pumps should be drained when taken out of service.

8.5.3.10 Pump winterization

Winterizing is required for services containing water and other fluids with pour points above minus 18°C but less than 10°C. Pumps are not to be heat traced:

a) Hydrocarbon pour point 0-10°C

Heat trace dead legs. Insulate but do not heat trace the lines to and from the pumps. Use backflow circulation to keep non-operating pump lines above pour point. Drain pumps when taken out of service during cold weather.

b) Aqueous Fluids

Trace and insulate all lines to maintain 24°C if required by climatic or process conditions Use back-flow circulation through non-operating pumps. Drain pumps when taken out of service during cold weather.

8.6 Miscellaneous Items

8.6.1 Hydrants, monitors, spray and deluge systems

8.6.1.1 Self-draining provisions shall be incorporated for fire hydrants used on underground piping. Monitors and hose reels shall be installed with self-draining or manually operated valves for above-ground piping and underground piping above the frost line.

8.6.1.2 Spray and deluge systems shall be drained through manually operated valves located at the main operating valve.

8.6.2 Emergency (safety) showers and eye-wash

8.6.2.1 Self drain yard hydrants shall be used for safety shower and eye-wash. For extreme climatic conditions provisions shall be taken to maintain the water temperature tolerable for users.

8.6.2.2 Heat tracing for winterizing piping to safety showers and eye-wash shall be thermostatically controlled electric heating.

8.6.2.3 Steam tracing shall not be used for piping of safety showers.

8.6.3 Drainage separators, sumps and lines

8.6.3.1 Separators and sumps should be provided with steam injection points or steam coils where necessary to keep the fluid in pumpable condition.

8.6.3.2 Drain lines from equipment should be suitably sloped and traced where necessary.

8.6.4 Chemicals and supplies

8.6.4.1 Chemicals and supplies shall be stored at temperature above their freezing point unless other storage temperatures are specified.

9. DESIGN

9.1 General

Steam tracing has the following limitations.

a) A steam supply and a condensate recovery system are needed. Both systems require sloped layouts and have distance limitations. This causes access issues with process valves and equipment maintenance.

b) Tracers operate at a temperature that corresponds to the steam saturation pressure. The minimum practical temperature of a bare tracer is 150 °C (300 °F).

c) Based upon a steam header pressure of 1.83 MPa (700 psig), the maximum practical steam tracer temperature is 260 °C (500 °F).

d) Bare steam tracers are too hot for non-metal or lined piping.

e) If heat tracing does not provide the needed fluid conditioning, other techniques such as diaphragm seals, purging, or liquid seals should be used.

f) The heat tracing should be controllable. For electric tracing this is usually accomplished by a temperature controller or current limited tracers. Steam heat tracing is normally controlled by limiting the steam pressure, but steam temperatures less than 150 °C (300 °F) normally are not practical.

g) Instruments have maximum temperature limits. Typically, for electronics this is 93 °C (200 °F) or less and about 120 °C (250 °F) for transmitter bodies.

A steam tracing pressure below 345 kPa (50 psig) is not recommended. Tracer pressures less than this are prone to plugging and do not have enough pressure to be recoverable by a condensate system. Where upward flow is unavoidable, steam pressure should be a minimum of 172 kPa (25 psig) for every 3 m (10 ft) of rise.

The following process design scenarios will be considered before selecting the tracing method to be employed for each plant line:

a) The consequences of an unplanned process shutdown during the worst-case ambient conditions.

b) Process control normal, upper and lower temperature restrictions.

c) If the tracing system is required to heat up the pipe or equipment, when the contents have become too viscous to pump or are in a solidified state, the acceptable heat-up time should be determined.

Given	Variable
Nominal pipe size	Tracer type, size and number
Desired pipe temp	Steam inlet temperature
Low ambient temp.	Insulation type and thickness

The following process design scenarios will be considered before selecting the tracing method to be employed for each plant line:

a) The consequences of an unplanned process shutdown during the worst-case ambient conditions.

b) Process control normal, upper and lower temperature restrictions.

c) The tracing system be required to heat up the pipe or equipment when the contents have become too viscous to pump or are in a solidified state. What is the acceptable heat-up time?

9.2 Internal Steam Tracing

9.2.1 Internal steam tracing is limited to lines of DN 150 and larger, for long outside plot lines below 100°C in noncorrosive service. Internal tracing is acceptable only if steam leakage into the product can be tolerated.

9.2.2 For DN 25 inner pipe tracers, the decreased flow area and pressure drop in process line should be checked.

9.2.3 Tracers shall not exceed 50 m length for 350 kPa (ga) or 3.5 bar (ga) steam, thus the maximum line length between two expansion loops can be 100 m.

9.2.4 For typical arrangement and details of internal steam tracing, see Appendix A of this Specification.

9.3 External Steam Tracing

9.3.1 General

9.3.1.1 The basic concepts and requirements for steam tracing systems of each project should be described in a project engineering specification. The Company's requirements specified herein shall be adhered to such specification.

9.3.1.2 The terminology used for steam tracing systems is:

- Tracing steam header, self-explanatory;
- Distribution manifold (DM), station to serve tracers;
- Leads, from DM to tracer;
- Tracer, heating pipe along process line;
- Tail, from tracer to CM;
- Collection manifold (CM), station to transmit condensate;
- Tracing condensate header, self-explanatory.

9.3.1.3 The level of pressure to be supplied for steam tracing supply and condensate return systems shall be specified for each project.

9.3.1.4 Light steam tracing

Temperatures that cause boiling or result in thermal degradation should be avoided. This can be a problem with level transmitter wet legs. The danger from overheating can be minimized by using light steam tracing. Light tracing uses insulation to separate the tracer from the process.

Light tracing should be considered for the following conditions.

a) When direct tracing of an instrument is involved.

b) When reducing thermal risk is necessary to comply with safety requirements.

c) When the heat transfer rate should be controlled to prevent corrosion or other unacceptable temperature related conditions.

d) When products; such as caustics, acids, amines, resins, and aqueous fluids require a low uniform heat.

Tracer tubes are available covered with an insulating polymer jacket. The insulation significantly reduces the tracer's surface temperature. However, this type of tubing has a larger bending radius than bare tubing. Insulated tracers are available that comply with ASTM C1055, which requires that human skin contact temperature to be less than 58 °C (136 °F).

A less desirable method of light tracing is using spacers made from inert moisture resistant solid ceramic board or compressed Rockwool.

Steam traced lines shall have an insulation, layer (spacer) between fluids flowing lines, tracer and fasteners to prevent high temperatures at contact points causing stress corrosion cracking of the pipe. Some products may be sensitive to temperature of hot spots. The product properties and the heating limitations shall be checked. For any of the following fluids are being handled, a protective layer or spacer shall be placed between the tracers and piping or equipment:

a) Acid or caustic fluids.

b) Heat sensitive fluids.

c) Fluids having electrolytic properties where hot spots will accelerate the corrosion rate.

Additionally, spacers shall be provided between tracers and piping or equipment which is lined with glass, rubber, plastic or other heat degradable materials. For spacer detail refer to Appendix D.

9.3.1.5 Piping in all sizes shall be individually traced.

9.3.1.6 Each heat tracing circuit shall have its own block valves at the supply and collection manifold. These valves shall be tagged with a metal tag designating the line or instrument served by number or description and shall indicate supply or return.

9.3.1.7 All heat tracing circuits shall be manifolded wherever possible at take-offs from the main supply and return headers with block valves at the headers.

9.3.1.8 When approved by the Company, external steam tracing may be replaced by other heating methods, i.e., electrical heating, internal steam or steam jacketed piping. Such alternates shall be shown and identified in specific job requirements.

9.3.1.9 The type of tracing, the purpose of the tracing, and the size of tracer shall be indicated on the flow diagrams using the following symbols:

a) Piping, (List the following symbols after piping number and specification):

ET*	Electric traced and insulation.
ETT*	Electric traced with heat transfer cement and insulation.
SJ*	Steam jacketed pipe and insulation.
ST*	Steam traced and insulation.
STS*	Steam traced with spacers and insulation.
STT*	Steam traced with heat transfer cement and insulated.

b) Valves, (List the following symbols next to the valve):

TB	Trace body and insulate.
TBB	Trace body and bonnet and insulate.

c) Equipment, (List symbol the following equipment title):

ST* 25 mm	Insulation-steam traced.
ET* 25 mm	Insulation-electric traced.

d) Instruments, (List the symbol next to the instrument number circle):

ST* Steam traced and insulated.

ET* Electric traced and insulated.

WS* Winter seal.

Note (*) specifies:

(W), Winterization or (H), Heat Conservation.

e) WISI on P & IDS shall have the tracer insulate from the line using 15 mm thick × 50 mm long × 25 mm wide blocks of insulating material at approximately 300 mm intervals. Blocks and tracer shall be banded to the pipe and the entire assembly insulated with an outer layer. A typical cross section of WISI is given in Appendix D-IV.

9.3.1.10 Steam tracer lines shall generally follow those listed below:

Line Traced, DN (in)	Traced, DN (in)
25-40 (1-1½) and smaller	10 (3/8) tubing
50, 80 and 100 (2, 3 and 4)	15 (½) tubing or pipe
150 to 300 (6 to 12)	15 (½) or 20 (¾) pipe
350 (14) and over	20 (½) or 25 (1) pipes

Contractors methods of determining heat transfer requirements shall be approved by the Company.

9.3.1.11 The following figures are minimum requirements as dictated by experience. However the figures may be adjusted by the Company for individual job specifications:

a) The lengths specified are the maximum permissible in all climates subject to freezing, and using 4.1 bar (ga) steam. Maximum lengths may be increased proportionally for higher pressure steam and shall be decreased proportionally for lower pressure steam.

Tracing Line (tracer)	Maximum Length
DN 15 (½ in) pipe or tubing and less	50 m
Over 15 (½ in)	100 m

b) Maximum depth of pocket shall be as below:

Steam Pressure		Pocket Depth
kPa(ga)	bar(ga)	m
280	2.8	3
410	4.1	4
520	5.2	6
690	6.9	8
1030	10.3	10

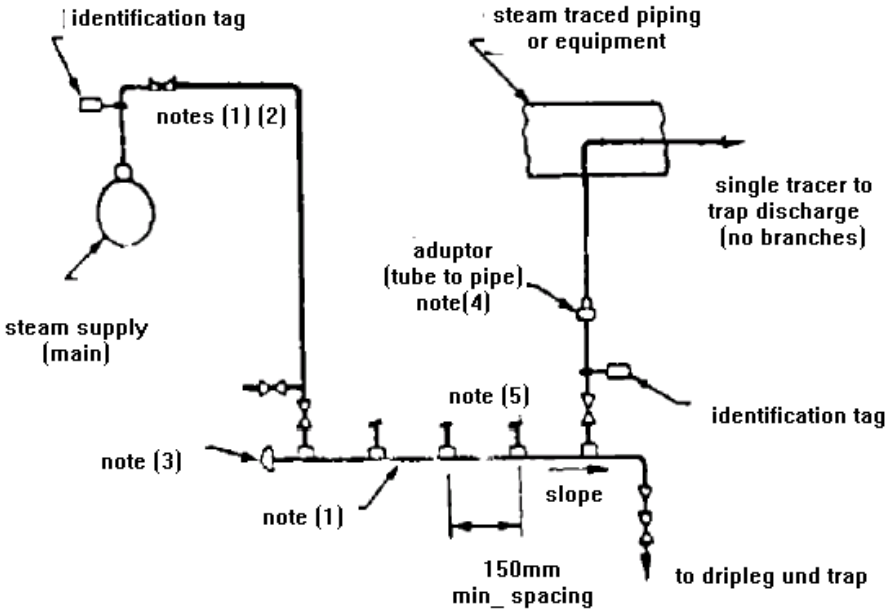
9.3.2 Steam supply

9.3.2.1 Steam tracing headers shall be supplied from the top of a main steam line, to avoid intake of condensate. The steam tracing header shall have a block valve as close as possible to the main header; so as to isolate the tracing system.

9.3.2.2 Block valves shall be provided at the high points of the branch lines in a horizontal position near the headers. The section of line between the header and the block valve shall be of minimum length (see Fig. 1).

9.3.2.3 Steam supply to individual tracers shall be taken from a distribution manifold and have a block valve for each tracer. This steam distribution manifold with all valves, drains and connections is the steam supply station.

9.3.2.4 For isolation during maintenance there shall be at least one flanged connection next to an isolating block valve between each manifold and its header. Tracer lines with a direct connection to the steam main line shall have a normally open block valve placed at the branch and a second valve near the line to be traced.



TYPICAL ARRANGEMENT OF PIPING AND TUBING COMPONENTS FOR STEAM SUPPLY AND DISTRIBUTION

Fig. 1

Notes:

1) All take off connections located at top of headers.

2) Block valves at main for each distribution header.

3) Preferential location of distribution header based on layout considerations to be; at accessible locations in elevated pipeways; at platforms; near grade.

4) Tube to pipe adaptor normally located at start of equipment or piping to be traced. At a change of material (material spec. break), the carbon steel piping shall be braced.

5) Tracer tubing shall be grouped together, whenever practicable, to permit insulation as a unit.

9.3.2.5 A separate steam distribution header shall be provided for tracing instruments and attendant piping, connected in such a manner that the instrument tracing will not be shut off when steam is shut off to other users. An exception is allowed for local pressure indicators, PD meters, gage glasses and control valves, which may be protected by the pipeline or equipment tracers.

9.3.2.6 The steam supply for tracers required continuously for equipment protection against ambient temperatures shall be independent of the steam supply required intermittently for winterization.

9.3.2.8 The number of individual tracers taken from a steam supply line or manifold header shall be as the following Table:

TABLE 1 - STEAM SUPPLY STATION

BRANCH FROM HEADER TO DM LINE SIZE DN (inch)	(DM) STEAM SUPPLY MANIFOLD SIZE DN (inch)	NUMBER OF LEADS		RECOMMENDED No. OF SPARE LEAD CONNECTIONS
		No. size DN 15 (½ inch)	No. size DN 20 (¾ inch)	
20 (¾)	25 (1)	1 - 2	1	---
25 (1)	40 (1½)	3 - 5	3	1
40 (1½)	50 (2)	6 - 15	4 - 6	1
50 (2)	80 (3)	16 - 30	7 - 12	2

9.3.3 Steam trapping

9.3.3.1 Each tracer shall have its own steam supply valve and trap.

9.3.3.2 Steam traps shall be grouped together on a condensate collection manifold. A maximum of 12 steam traps shall be connected to one condensate-collecting manifold.

9.3.3.3 Valves and piping at trap shall be same size as trap size.

9.3.3.4 All steam traps shall have strainers upstream of the trap or shall have integral strainers. All strainers shall be equipped with blowdown valves.

9.3.3.5 The back pressure on the steam traps shall not be higher than that recommended by the trap manufacturer.

9.3.3.6 All steam condensate piping including trap discharge to the header shall be sized for two-phase; i.e., they should be sufficiently large to handle the condensate and any flashed steam.

9.3.3.7 Condensate recovery shall be 100%, however in exceptional condition when approved by the Company, the cases where it is not practicable to recover, discharge piping shall be short, without elbows and discharged into sewage or a properly designed soakaway sump. However, alternative means of tracing (electrical), should also be considered.

9.3.3.8 Inverted bucket type traps shall be acceptable where there is no danger of condensate freezing. Such applications shall be subject to Company's approval.

9.3.3.9 In severe climate if requested by Company, steam traps on process Units should be protected by enclosing them in cabinets of steel or other suitable materials. Each cabinet should contain at least six traps and allow easy access for maintenance.

9.3.3.10 Isolating block valves for steam traps, should be provided for winterizing services.

9.3.3.11 Traps shall be preferably installed with the flow down. If the trap is in a horizontal run, it shall be installed on its side to prevent freezing.

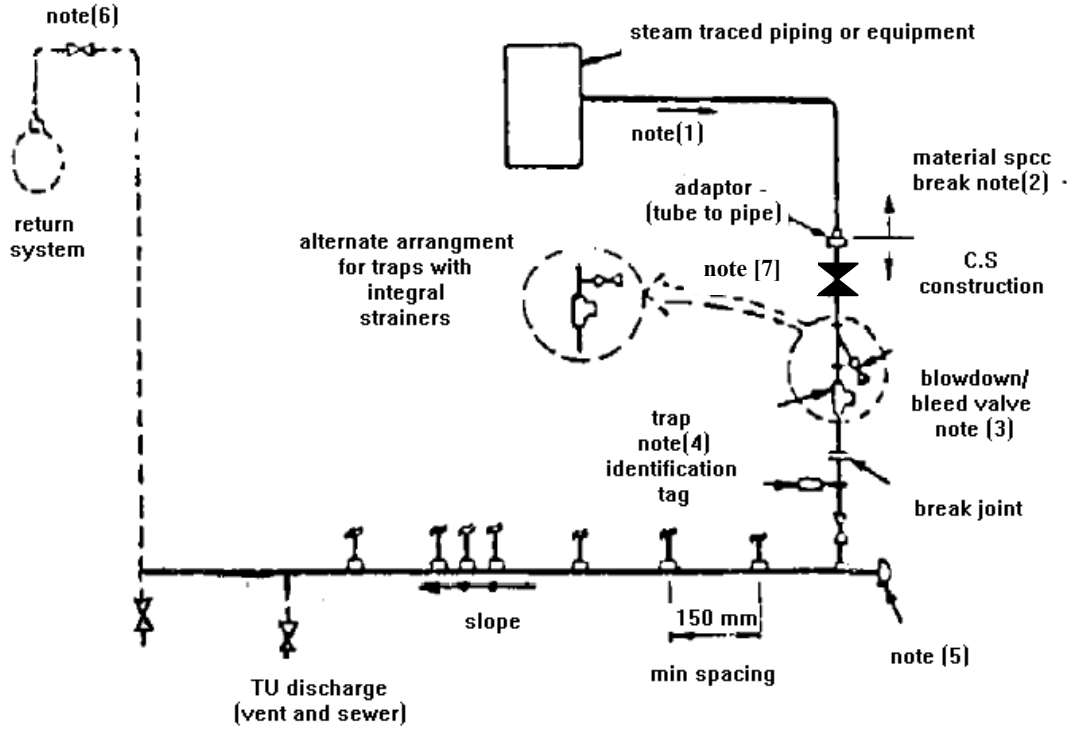
9.3.4 Condensate removal

9.3.4.1 Tracer condensate header connections on condensate mains shall be shown on drawings.

9.3.4.2 A typical arrangement of piping and tubing components is illustrated in Fig. 2.

Condensate collecting piping for grouped tracer traps shall be such as to avoid excessive back pressure on traps and trap discharge lines, and should be based on the lowest expected steam supply pressure. Minimum size of condensate collecting piping for grouped tracer traps shall normally be as follows:

- 1 to 2 traps DN 20 (¾ inch)
- 3 to 5 traps DN 25 (1 inch)
- 6 to 15 traps DN 40 (1½ inch).



CONDENSATE COLLECTION STATIONS

Fig. 2

Notes:

1) Tracer configuration to permit gravity flow of condensate to traps. If a tracer must rise vertically 1 m or more, it must be trapped before the vertical rise also.

2) Tube-to-pipe adaptor normally located at end of "effective tracer" of equipment or piping being traced.

3) Y Type strainer required unless trap is furnished with an integral strainer.

4) Orientation of traps and isolating block valves to be vertical whenever practicable. Traps shall always be installed to assure selfdraining.

5) Collection header and steam traps shall be located near grade or at platform.

6) Connection to return system shall be located at top of header.

7) In operational point of view, the isolating block valve should be installed on upstream of steam trap.

9.3.5 Steam tracing lines (tracers)

9.3.5.1 Tracer shall be held in place with steel bands or 1.5 mm soft galvanized wire loops spaced 1 meter apart. On tracers DN 20 (¾ inch) and larger spacing may be increased to 1.5 meters.

9.3.5.2 Single or multiple tracers shall be used, depending on pipe size and heat transfer requirements. Tracers shall be DN 15 (½ inch) and DN 20 (¾ inch) seamless steel pipe schedule 80, for pipes DN 40 (1½ inch) up to and including DN 600 (24 inch).

9.3.5.3 Tracers shall be in contact with piping or equipment except where spacers are specified.

9.3.5.4 The material of system tracers shall be followed and used as per IPS-E-PI-221 and as herein below:

a) Steam tracing lines shall be carbon steel pipe to ASTM A-53, Grade B, API 5L Gr.B, or soft annealed copper tubing to ASTM B-68 or equal or exceptionally steel tubing to ASTM A-179 as specified herein. Tubing is only acceptable in locations where piping is not practical, such as burner manifolds and instrumentation.

b) Copper tubing shall not be used where steam or process temperature exceeds 200°C.

c) The use of type 304 stainless steel seamless tubing to (BS 3605, Grade 801 or ASTM A-269) with stainless steel compression fittings is acceptable.

d) Minimum tube wall thickness shall be in accordance with data as specified in Table 2 below:

TABLE 2 - MINIMUM TUBE WALL THICKNESS

Size		Steel Tubing		Copper Tubing	
DN	(inches)	mm	(inches)	mm	(inches)
10	(3/8)	0.86	(0.034)	0.81	(0.032)
15	(½)	1.24	(0.049)	0.81	(0.032)
20	(¾)	1.24	(0.049)		
25	(1)	1.65	(0.065)		

9.3.6 Installation of tracers

9.3.6.1 Piping tracers shall be installed as follows:

a) Horizontal pipe

Along the bottom half of the pipe, for pipe sizes DN 40 (1½ inch) and smaller the tracer may be helically wound.

b) Vertical pipe

Multiple tracers equally spaced around the circumference. Single tracers shall be helically wound.

c) Pipelines supported by shoes or similar devices shall have the bottom tracer located as closely as possible to the support.

d) Tracing of the run pipe shall extend to the first block valve of any branch connection.

e) For service operations sensitive to cold spots (waxes, asphalts, sulfur, etc.), the points where tracers leave the insulation shall not be coincident, to avoid leaving any pipe length totally untraced.

f) Flanges, valve bonnets and packing glands shall be traced only when specified. When such components are not to be traced, the run tracer shall be bent to follow the contour of the main pipe.

g) Bends shall be used wherever practical and fittings kept to a minimum. Unions shall be used

when an item is traced and its removal is required for frequent maintenance.

h) Joints in tracing lines should be located at pipe flanges. Expansion loops should as far as possible, be installed in horizontal plane and pockets should be avoided.

i) Expansion loops shall be provided for all straight runs of tracers longer than 7.5 m unless otherwise specified as follows:

1) Spacing shall not exceed 30 m.

2) The sum of the effective legs of the loops shall be at least 0.6 m for 7.5 m runs, and 1 m for 30 m runs.

3) Loops shall be oriented to be self drained.

j) The number of tracing line required and the arrangement of tracing line(s) around the pipe shall be specified on the basis of the pipe size and severity of the flowing fluid and climatic condition. X-Section of a typically single and multiple arrangement of tracer illustrated here in Appendix D-I, II, III.

9.3.6.2 Where control valves and by-passes are traced, the tracing should be arranged so that the control valve can be removed without interfering with the tracing of the by-pass.

9.3.6.3 Each individual tracing line should be provided with its own trap and, in parallel systems, to each leg. Groups of tracers which are self-draining may be arranged to drain to a level controlled condensate pot or a collection header with an integrated type of steam trap.

9.3.6.4 Each tracing line shall have it's own steam supply valve, and steam trap. Piping connections to steam and condensate headers will be shown on the piping arrangement plan drawings and isometric drawings.

9.3.6.5 No provision shall be made for expansion movement of 13 mm or less on DN 15 and smaller tracers, since the sag or offset will take care of this amount of expansion.

For tubing or piping tracers larger than DN 15, anchoring shall generally be made at the midway point, and the piping arrangement at the ends of the tracers shall be sufficiently flexible to allow for expansion of tracers.

Where it is impossible to allow for end movements, or in cases where for special reasons the unanchored length of pipe tracer exceeds 40 meters, expansion loops shall be provided. Minimum radius of expansion loop shall be 6 time the outside diameter of the tracers at bends of loop.

9.3.6.6 Insulation shall be slotted at expansion loops, and at anchored tracer ends where the tracers leave the pipe.

9.3.6.7 Anchors or guide clips shall be installed on tracers near valves, flanges, expansion loops and turns to avoid damage to insulation due to tracer expansion.

9.3.6.8 Tracers connections and fittings shall be provided under the following considerations:

a) The use of threaded fittings shall be minimized.

b) Threaded pipe fittings shall be seal welded except at steam traps and piping downstream of traps.

c) Break joints in tracer system shall be provided at equipment which must be removed for maintenance. Tracer fitting break joints and all other mechanical joints shall be located outside of the equipment insulation.

9.3.7 Instrumentation tracer installation

Tracer arrangements for instrumentation shall be per API RP 550. Section 8 except as modified below:

a) Tubing tracer size shall be as shown in Table 2 of this Standard.

b) Lead lines for differential pressure instruments shall have common heating and insulation.

c) The selection of "light" or "heavy" tracing methods shall be based on the following criteria-

heating does not:

1) Boil away the process fluid in the lead lines, or,

2) Heat the instrument above its recommended maximum operating temperature.

d) Instrument houses shall be large enough to accommodate the valve manifold so that separate heating and tracing of the valve manifold is not required.

9.4 Insulation

Insulation for traced piping shall be in accordance with insulation specification IPS-C-TP-701. In addition, the following design criteria shall be considered.

a) The thickness of insulation used shall be in accordance with the project specification.

b) The insulation cover shall be applied tightly around the line and tracer. All tubing unions are to be made outside of the insulation and separately wrapped with non-asbestos ropes.

c) The following components of tracer system shall not be insulated:

1) Traps.

2) That portion of trap inlet piping required to be kept uninsulated for proper operation of the trap.

3) Traced pipelines in sleeves under road crossings or similar underground routing. In such cases the insulation shall be terminated at about 300 mm within the sleeve.

d) Traced lines shall be covered with oversized or "extended leg" insulation.

e) When the plant is installed in a location where prolonged freezing temperatures are likely to occur, the condensate recovery piping shall be insulated and where practical, insulated together with the associated steam piping.

9.5 Steam Jacketing

Where heat input into process piping is required (such as asphalt and liquid sulphur services), and when steam or electric tracing using heat transfer cement is impractical, steam jacketing of piping shall be used. All steam jackets shall be provided with valved drains at the low points.

9.6 Identification

Identification tags shall be permanently installed at each end of the tracer. Tags shall identify the equipment or pipeline being traced whether tracing is for winterizing or process protection and the location of the inlet valve (supply point) and trap.

9.7 Inspection and Testing

9.7.1 For inspection and testing of thermal insulations refer to IPS-E-TP-700.

9.7.2 For steam tracing system the following visual inspections shall be made prior to insulating:

a) Tubing and pipe bends shall be visually inspected for kinked or flattened sections. All such sections shall be cut-out and replaced.

b) Tracer attachment shall be checked to ensure freedom of movement towards expansion loops.

c) Tracer attachment shall be inspected at expansion loops, at equipment break points, and at other changes of direction where movement of the tracer could damage the insulation.

9.7.3 The tracer system shall be pressure tested, prior to insulation. Hydrostatic pressure of pipeline shall be at least 700 kPa or 1½ times design pressure whichever is greater.

9.8 Electrical Tracing

9.8.1 Electrical Tracing Advantages

Electric tracing has the following advantages.

a) Electric tracing can maintain a broad range of temperatures from a few degrees above ambient to 500 °C (930 °F).

b) Unlike steam, electrical tracing has the ability to provide minimal heat.

c) It is possible to accurately maintain the desired temperature.

d) There are no fittings or traps that could leak or require maintenance.

e) Individual tracers are more reliable and easier to monitor.

f) Tracer installation is simpler.

g) Electrical supplies are easier to route and do not tend to be an obstruction to operations and equipment maintenance.

h) Purposed design digital controllers with serial communications are available.

i) Standards and agency certifications help ensure a consistent installation.

Electric tracing is often recommended for use with temperature sensitive materials that should be maintained within a narrow temperature range; e.g. caustic and amine.

9.8.2 Electric Tracing Limitations

Electric Tracing has the following limitations.

a) Standard electric heat tracing for temperature maintenance has a slow heat-up

b) Period after an emergency shutdown or a plant turnaround.

c) The number of tracers dramatically increases as the process maintenance temperature approaches the electrical T-rating. In some circumstances the desired process temperature cannot be achieved with electrical tracers.

d) In Division 1 hazardous areas, electric tracing circuits are severely restricted or prohibited.

9.8.3 Electric tracing should be used in preference to steam tracing under the following conditions:

1) Where the temperature must be accurately controlled or limited. Temperature control by throttling or on-off control of steam is usually not practical because of water logging of sections of the tracer, freezing problems, and temperature gradients along the length of the tracer. Some examples of lines that require temperature control are as follows:

a) Water lines to safety showers and eyewash fountains because of safety hazards if line is overheated.

b) HF, H_2SO_4 and NaOH lines in certain concentrations because of corrosion or stress-corrosion cracking at elevated temperatures.

c) Fuel oil lines where high steam temperatures would cause coke formation and fouling of the line.

d) Boric Acid lines in -7°C to -1°C. Temperature must be maintained within a -7°C to -1°C band to prevent precipitation both above and below a certain temperature range.

2) Where instrument lines are monitoring and controlling important processes.

3) When lined pipes are used to avoid corrosion and/or abrasion. Most rubber and polymer linings should not exceed 93°C.

4) Where plastic pipes and tanks are used.

5) Where the minimum ambient is less than -12°C for instrument lines because of condensate freezing problems that occur with steam tracing.

Note:

When minimum ambients are below -12°C, strong consideration should be given for electric heat tracing of traps on steam tracing systems.

9.8.4 Electrical tracing shall be used as specified in the job specification. For detailed requirements of engineering and construction refer to IPS-M-EL-190, and following general consideration:

a) Due consideration should be given to the classification of a dangerous area and all equipment specified accordingly.

b) Consideration shall be given but not limited to: environmental conditions, pipe material, pipe size and length, fittings, type and thickness of insulation, lowest ambient design temperature, fluid flow conditions, type of control required such as thermistors, thermostats, etc. and area classification.

c) Overlimit thermostats shall be used with constant wattage heaters.

d) Electric tracing used underground shall be designed to allow maintenance without any requirement for excavation.

e) Installation involving a major amount of heat tracing shall include a central indication panel, whereby the status of each loop shall be monitored with a current transformer.

f) All thermostatic devices shall be enclosed in an approve enclosures by the Company.

g) All installation shall be in conformity with manufacturer's recommendation. The manufacturer's data shall be utilized along with published charts to determine the size and amount of cable to be installed.

h) Thermostats shall be installed to maintain desired temperatures.

i) All mineral insulation (MI) cable installation shall be continuous run. Each run shall be supplied with individual thermostat.

9.9 Use of Heat Transfer Cement

9.9.1 Heat transfer cement shall be utilized on tubing when a process line requires a high heat input and more than three tracers would be required when using 4 bar (400 kPa) steam. All tubing joints must be outside the insulation in heat transfer applications.

9.9.2 The heat transfer cement when required to be used shall have the following specification and characteristics unless otherwise specified.

a) Thermal conductivity 13.02 W/m.K (11.2 k cal/m^2/h/°C/cm).

b) Electrical resistance 0.635 ohms/cm^2/cm.

c) Specific heat 0.209 J/kg/°C(0.50 k cal/kg/°C).

d) Linear shrinkage 1 percent maximum.

e) The linear coefficient of thermal expansion should be approximately the same as for materials of pipeline and tracer.

f) Compressive and tensile strengths should be high enough to withstand stresses due to differential expansion and contraction.

g) The heat transfer cement should be non-reactive with the materials of the pipeline, tracer, and insulation.

h) The heat transfer cement should be aircuring, weather resistance and capable of application by unskilled labor without the use of special equipment.

9.9.3 Heat transfer is increased by using heat transfer cement or mastic. A single tracer using mastic can replace multiple tracers. A bare steam tracer has difficulty maintaining temperatures above 71 °C (160 °F). Poor initial contact between the tracer and the line, which can be further exacerbated by thermal expansion, makes it difficult to maintain an exact temperature.

10. Special Applications

The following special circumstances exist.

a) Heated full enclosures are needed in arctic services since the ambient temperature drops below the operating temperature of the instrument electronics.

b) Electric tracing can be used to improve measurement accuracy by maintaining a transmitter at a constant temperature inside a full enclosure. It can also be used to improve the time response of a

diaphragm seal system by lowering the fluid viscosity. Tracing can also be used to improve the accuracy of a diaphragm seal system by maintaining a constant temperature along both sides for their entire length.

c) Since they are self-draining displacers, magnetic level indicators and gauge glasses in hydrocarbon services do not need protection from collecting water.

d) It is not considered economical to provide a dedicated tracer for a pressure gauge. Rather, a pressure gauge is provided with a diaphragm seal and tightly coupled to the pipe and insulated.

e) As an alternative to tracing for climate protection, impulse lines can be filled with an insoluble seal liquid.

f) Regardless of the header temperature, condensate filled impulse lines in steam service need to be protected from freezing by tracing or be provided with a non-freezing seal liquid.

g) In viscosity control services, liquid seals or diaphragm seals are often needed to protect transmitters from the tracers as well as the process.

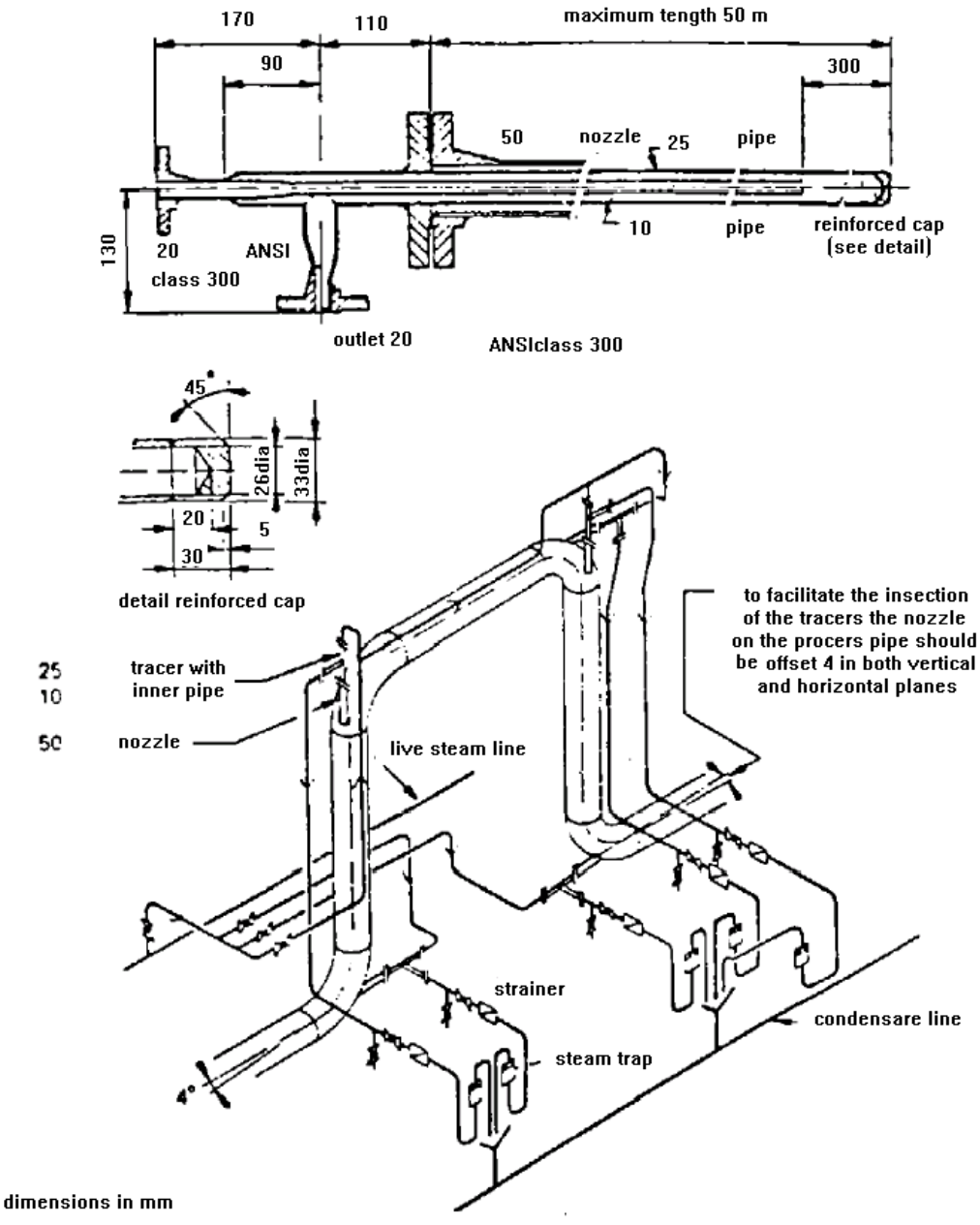
h) Some purge fluids when steam traced (e.g. heavy gas oil) might exceed the instrument temperature rating, so a diaphragm seal or liquid seal might be necessary. On the other hand, electric tracing often has the advantage that its temperature can be set between the viscosity control point and the maximum instrument body temperature.

i) Steam tracing might be the only option when the electrical classification T-rating or the auto-ignition temperature of the hazard causing vapor cannot be met. API 2219 states, “In general, ignition of hydrocarbons by a hot surface should not be assumed unless the surface temperature is approximately 182 °C (360 °F) above the accepted minimum ignition temperature of the hydrocarbon involved.” Accordingly, high process surface temperatures are rational so the use of steam tracing is suitable.

APPENDICES

APPENDIX A

TYPICAL DETAILS OF INTERNAL STEAM HEATING



Dimensions in mm.

APPENDIX B

TYPICAL PIPING EXTERNAL TRACING DETAILS

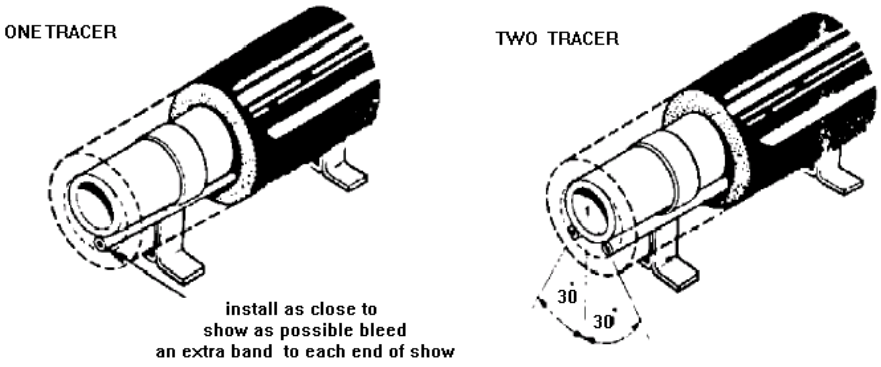
B.1 Line Tracing Details

1) Tracers on vertical pipes are to be equally spaced around pipe.

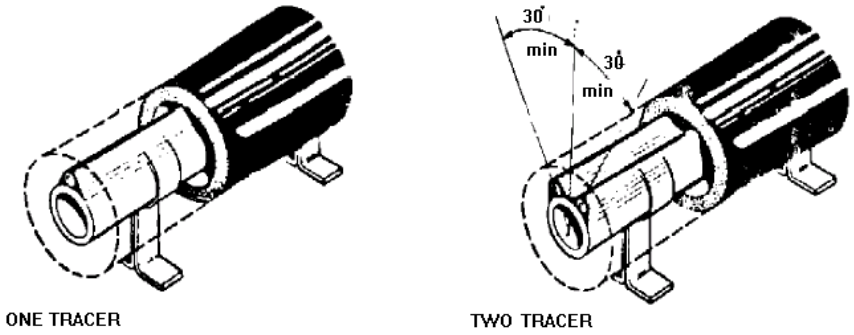
2) Guide clips and anchors are to be installed every 300 mm.

3) Tracers are to be banded to pipe with 12.7 × 0.38 mm stainless steel bands installed tight enough to make tracers contact pipe without crimping or deforming tracer tubing.

Tracer Installation without Cement



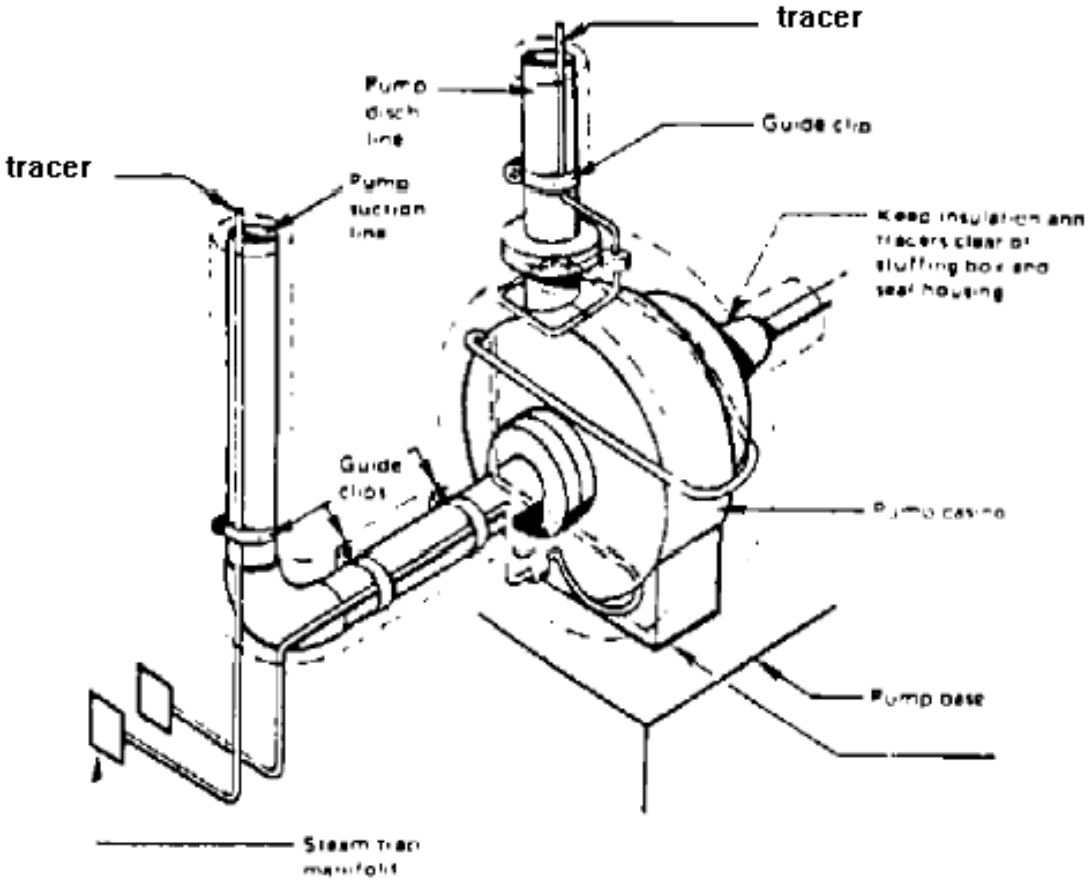
Tracer Installation with Cement



APPENDIX C

TYPICAL PUMP TRACING DETAILS

Pump Tracing

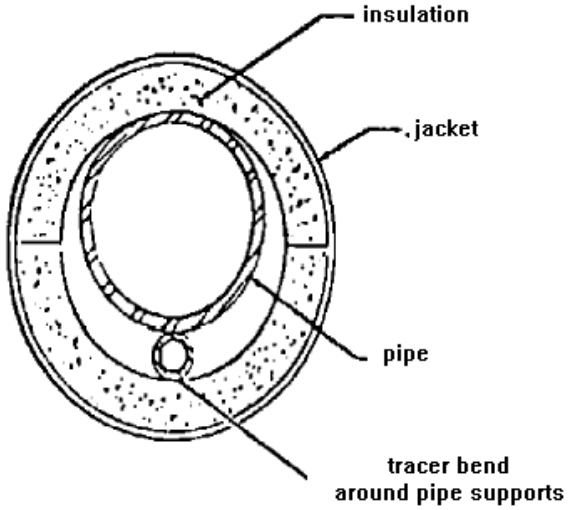


Note:

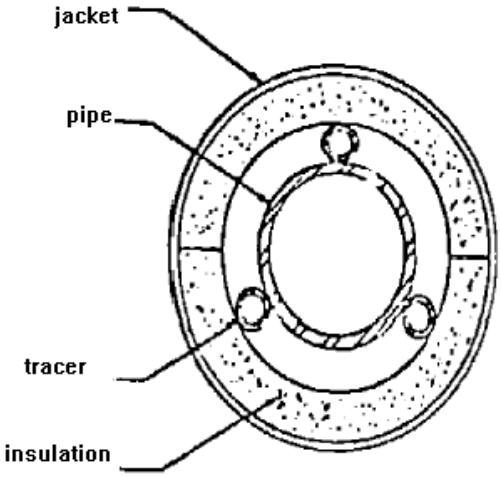
Calculate length of tracer required to maintain desired temperature.

APPENDIX D

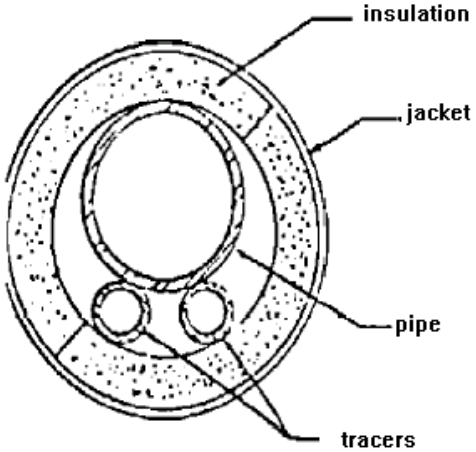
TYPICAL X-SECTIONS FOR REQUIRED EXTERNAL TRACING



Single Tracer
I

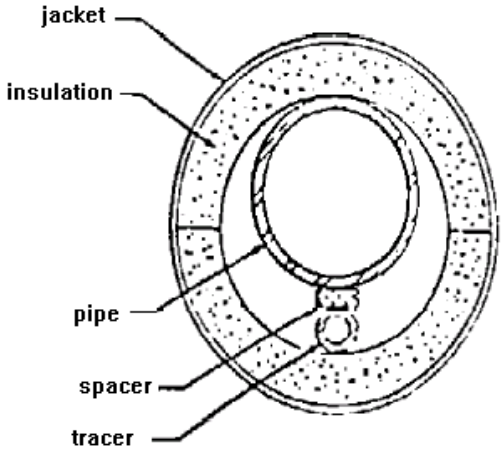


3 or More Tracers Equally Spaced
II



Double Tracer

III



WISI

Winterize Insulator, Steam Trace, Insulate

IV