MANUAL

PROTECTIVE STEAM HEATING OF PIPING SYSTEMS

DEP 31.38.30.11-Gen.

December 1997

DESIGN AND ENGINEERING PRACTICE

PREFACE

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Shell International Oil Products B.V. (SIOP)
and
Shell International Exploration and Production B.V. (SIEP)
and
Shell International Chemicals B.V. (SIC)

The Hague, The Netherlands,

and other Service Companies.

They are based on the experience acquired during their involvement with the design, construction, operation and maintenance of processing units and facilities, and they are supplemented with the experience of Group Operating companies. Where appropriate they are based on, or reference is made to, national and international standards and codes of practice.

The objective is to set the recommended standard for good design and engineering practice applied by Group companies operating an oil refinery, gas handling installation, chemical plant, oil and gas production facility, or any other such facility, and thereby to achieve maximum technical and economic benefit from standardization.

The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where DEPs may not cover every requirement or diversity of condition at each locality. The system of DEPs is expected to be sufficiently flexible to allow individual operating companies to adapt the information set forth in DEPs to their own environment and requirements.

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NOTE: In addition to DEP publications there are Standard Specifications and Draft DEPs for Development (DDDs). DDDs generally introduce new procedures or techniques that will probably need updating as further experience develops during their use. The above requirements for distribution and use of DEPs are also applicable to Standard Specifications and DDDs. Standard Specifications and DDDs will gradually be replaced by DEPs.

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APPENDICES

1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for protective steam heating of piping systems (excluding transmission pipelines).

This DEP is a revision of an earlier DEP of the same number, dated September 1991.

Hot oil and hot water protective heating systems are excluded from the scope of this DEP.

Design requirements for steam distribution systems are also excluded from the scope of this DEP.

Also excluded from the scope of this DEP is electrical trace heating, for which DEP 33.68.30.32-Gen. applies.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by SIOP and SIEP, the distribution of this DEP is confined to companies forming part of the Royal Dutch/Shell Group or managed by a Group company, and to Contractors and Manufacturers nominated by them (i.e. the distribution code is "F", as defined in DEP 00.00.05.05-Gen.).

This DEP is intended for use in oil refineries, chemical plants, gas plants and, where applicable, in exploration and production facilities and supply/marketing installations.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this DEP the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned with the object of obtaining agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party which carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party which manufactures or supplies equipment, technical documents/drawings and services to perform the duties specified by the Contractor.

The **Principal** is the party which initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions

CM	Collecting Manifold for steam tracers
DM	Distribution Manifold for steam tracers
lead	the steam line from a DM to a tracer
steam trap	an automatic device used to remove condensate from a steam system with a minimum loss of live steam. For terminology and diagrams of steam traps, reference is made to ISO 6704.
Tail	the steam line from a tracer to the CM
tracer	steam heating piping which runs along the process pipe

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets. Other documents referenced by this DEP are listed in (9).

2. GENERAL

Heating is usually required if a temperature drop below a particular value would cause:

- coagulation, crystallisation, paraffin separation, congealing or hydrate formation;
- condensation of process gas;
- process fluids to become too viscous;
- freezing (and expansion) of water-containing process fluids;
- brittleness of piping material.

The following heating systems are described in this DEP:

- steam tracing: - permanent heating
- - winterising
- steam jacketing: - fully jacketed
- - not fully jacketed

The heating medium for tracing and jacketing should be saturated low pressure (LP) steam. However, medium pressure (MP) steam may be used.

A steam tracer heating system may be:

- a closed system in which the condensate is collected for re-use;
- an open system in which the condensate is discharged into a drain or soakaway.

Tracing steam and condensate headers should be separate from the normal steam distribution and condensate collecting system.

For large systems (as defined by the Principal) separate 'winterising' headers shall be installed to allow the system to be preserved when not needed (e.g. in summer). This is done by closing the condensate valves and leaving the steam valves open. They are then to be flushed before start-up in the winter.

Piping in steam service shall be arranged so that condensate accumulation is avoided.

All steam pipes shall have drain facilities at the low points and at the end to remove condensate (e.g. during commissioning).

The requirement for protective heating of piping and instruments shall be indicated on the process engineering flow schemes and on the piping data sheets (see also 4.)

3. DESIGN AND ENGINEERING

3.1 STEAM TRACING

In steam tracing systems, the steam tracers are attached to, and insulated together with, the process piping. For insulation, see (7).

Steam traced caustic soda (NaOH) lines shall have an insulation layer between process line, tracers and fasteners to prevent high temperatures, which would promote caustic stress corrosion cracking of the pipe, at contact points.

Carbon steel tracers used on stainless steel process lines shall have isolation blocks (e.g. ceramic board) between the tracer and the process line.

Other process fluids may be sensitive to hot spots from line contact with tracers. Therefore, the process fluid properties and heating limitations shall be checked by corrosion and process engineers. If spot heating is not acceptable, insulation shall be placed between process line, tracers and fasteners. The piping data sheets shall mention this specific installation requirement under 'Remarks'.

For each steam tracing application, the heat loss shall be calculated. The heat input together with the local weather conditions and the insulation system will dictate the number and size of the tracers per application.

Tracers shall be DN 15 or DN 20 seamless steel pipe, schedule 80.
Single or multiple tracers are used, depending on pipe size and service. Guidance on the number and size of tracers required for different line sizes and conditions is given in the following table:

Table 1 Number and size of tracers

	Process pipe nominal diameter (DN)					
	Up to 40	50 - 200	250 - 300	350 - 450	500	600
	Number and size (DN) of tracers					
Winterising	1 x 15	1 x 15	1 x 15	1 x 20	1 x 20	1 x 20
Solidification below 24°C	1 x 15	1 x 15	1 x 15	1 x 20	1 x 20	1 x 20
Solidification between 24 and 66°C	1 x 15	1 x 15	1 x 15	1 x 20	2 x 15	2 x 20
Solidification between 66 °C and 100 °C (Note 1)	1 x 15	2 x 15	3 x 15	3 x 20	4 x 20	4 x 20

Notes:
1. A higher steam pressure may be required.
2. For sample transport lines (i.e. for on-line process stream analysis), at least two DN15 tracers (or as shown in the above table, whichever provides the higher heat input) are required if the pour point of the product is above the minimum ambient temperature.

For the above table, the parameters used are:

- LP Steam 3.5 bar (ga), 150°C;
- 50 mm mineral wool insulation for lines up to and including DN 100;
- 90 mm mineral wool insulation for lines DN 150 to DN 600;
- air temperature = minus 10 °C;
- wind velocity = 10 m/s.

Tracers shall not be provided with branches.

Each tracer shall have a valve just after the steam supply header and just before the condensate header.

Tubing can be used for tracing of in-line equipment such as strainers. Copper, carbon steel or stainless steel tubing may be used depending on the method of application.

Tracers shall follow the contours of the piping to be heated from the highest point sloping towards the steam trap. Pockets should be avoided, and the maximum accumulated pocket depth is 3 m.

Single and multiple tracers shall run along the underside of horizontal lines, or at either side of the supporting shoes. For details see (Appendix 2).

Multiple tracers may be connected to a common steam supply line, but each shall have an individual steam trap and block valve.

If systems are designed to discharge sub-cooled condensate (i.e. below saturated steam temperature), extra care shall be taken to ensure a constant slope of the tracer towards the steam trap, in order to avoid excessive water hammer effects.

Multiple tracers on vertical pipes shall be equally spaced around the circumference of the pipe.

Tracers on straight lines shall have expansion loops at 20 m intervals. At line flanges the tracer shall also have flanges to permit dismantling.

Maximum length of tracers

Steam pressure bar (ga)	Tracer size DN	Maximum length of tracer (m)
3.5	15	40
	20	50
17.5	15	60
	20	100

For other steam pressures the maximum tracer length can be established by interpolation or extrapolation.

Tracing of valves shall be executed so that the valve can be disconnected without removing the tracer lines. For details see Appendix 5 and 6.

Tracing at trunnion support locations is indicated in Appendix 4.

For tracing of instrument impulse lines, please refer to DEP 32.37.10.11-Gen.

3.2 STEAM JACKETING

For typical details see (Appendix 3).

The process lines are in the centre of larger diameter steam lines. This is applied for services which require a high heat input. Steam pressures up to 20 bar (ga) may be considered.

The wall thickness of the inner pipe shall be designed to withstand the external pressure exerted by the steam in the outer pipe. Differences in expansion shall be checked during detailed design (for reference see BS 5500 chapter 3.11).

The inner and outer pipe shall be of the same grade of material.

Butt welds of the pipe within the jacket should be avoided. Otherwise these welds shall be inspected and tested in accordance with DEP 31.38.01.31-Gen.

For consistency, jacketed lines shall also be identified in the Contractor's specification for piping systems.

Generally, there are two methods of jacketing:

- fully jacketed from flange to flange, having jacketed valves
- partly jacketed, having traced valves.

The use of fully jacketed lines shall be restricted to a minimum for economic reasons and because of the bulky configuration. Fully jacketed lines are used when it is critical to maintain the process fluid within a narrow temperature range. Fully jacketed lines are used for very waxy process fluids, liquid sulphur lines, when rapid scaling (even on valves/flanges) can be expected, and for slurry lines in polymerisation units, etc. The inner pipe (process line) shall have oversize (reducing type) flanges, allowing the jacket to run from flange to flange. The valves shall also be jacketed and have flanges of a size corresponding to the jacket size.

"Not-fully" jacketed lines should be used when there is still a high heat input demand but it is less critical to maintain the process fluid within a narrow temperature range. Typical applications are viscous slurry suction lines, drain collecting lines in trenches, etc. The jacket shall be swaged to the inner pipe (process line) as close as possible to the process line flanges. The valves are traced and are the same size as the process line flanges.

The annular space between the process and jacket pipes shall be maintained by spacers, welded to the inner pipe at maximum 3 m intervals. Jacketed pipe spools shall have a maximum length of 6 m.

Each jacketed pipe spool shall have three nozzles supplied with welding neck flanges on the jacket. At one side there shall be a nozzle for steam supply; at the other side, there shall be one nozzle for condensate discharge and one nozzle for jump-over.

The steam inlet nozzle and the jump-over nozzle shall be located in line (on top if a horizontal line); the condensate discharge nozzle shall be located opposite the jump-over nozzle (at the bottom if a horizontal line).

The nozzles shall be located as close as possible to the flanged spool ends.

The steam inlet nozzle shall have a 3 mm thick wear (impingement) plate welded to the inner pipe.

Steam shall be fed to the steam inlet nozzle of the jacket. Each pipe spool shall have its own steam trap. The steam flow shall continue via the jump-over nozzle to the steam inlet nozzle of the next spool, and so on. This is referred to as a "jacket circuit".

Each circuit shall have its own fresh steam supply. The requirements for the steam supply and condensate return are similar to those for the tracing system, see (2.4).

The maximum length of a jacket circuit depends on the pressure drop and heat loss in the steam system.

Although typical steam jacketed systems are normally relatively short, some steam jacketed systems perform satisfactorily with circuits longer than 1 km. Such long circuits require temperature alarm instruments.

Test pressures and conditions for jacketed spools shall be determined, and stated on the relevant documents (e.g. isometrics).

The steam condensate and jump-over piping shall be routed so that minimum forces will be transferred to the nozzles.

3.3 SUPPLY AND RETURN SYSTEM

3.3.1 General

A typical arrangement of a steam tracing system is shown in (Appendix 1).

A steam tracing system shall be designed to minimise potential leaks. Therefore, the number of flanges and valves shall be restricted as far as possible. In determining the number of valves, the question of performing repairs on steam traps on live lines should be considered. See Section 8.

Steam traps and valves should be of the socket weld type and valves should have welded bonnets.

Block valves should only be installed upstream of a distribution manifold and downstream of a collecting manifold.

Although tracers fed from one distribution manifold should discharge into one collecting manifold, this is often not possible. In systems where tracers from one distribution manifold will discharge into several collecting manifolds, block valves in the leads shall be considered to allow maintenance without total steam tracing shut-down.

Connections on distribution and collecting manifolds shall be provided for tracing of instruments where specified. See DEP 32.37.10.11-Gen.

3.3.2 Steam supply

Tracing steam headers shall be supplied from the top of a main steam line, to avoid intake of condensate. The tracing steam header shall have a block valve as close as possible to the main steam header, for isolation of the tracing system. Steam supply to individual tracers shall be taken from a distribution manifold.

For line sizing requirements see DEP 31.38.01.11-Gen.

For isolation during maintenance, there shall be at least one flanged connection next to the isolating block valve between each manifold and its header.

Distribution manifolds shall be installed where a minimum of 3 leads can be grouped together.

Recommended spare lead connections as per following table.

Size of Distribution Manifold

Size of branch from header to DM (DN)	Size of DM (DN)	NUMBER OF LEADS		Recommended number of spare lead connections
		Nominal diameter DN 15	Nominal diameter DN 20	
25	40	3 - 5	3	1
40	50	6 - 15	4 - 6	1
50	80	16 - 30	7 - 12	2

Single tracers, with direct connections to the tracing steam and condensate headers, shall only be applied in areas with less than 3 steam tracers and for lines which must retain steam heating at all times.

The distance from the lead to the actual tracer shall be minimised.

3.3.3 Steam trapping

There are three different groups of steam traps, each with its own working principle:

- Mechanical steam traps (bucket, inverted bucket and float type)
- Thermostatic steam traps (bi-metallic and float membrane)
- Thermodynamic steam traps

For steam trace systems which discharge condensate at saturated steam temperature, mechanical traps (steam traps with open inverted floats) or thermodynamic traps should be selected. The former type will work better at high back pressure and is somewhat more resistant to fouling. The latter type has more resistance to water hammer and steam pressure drop and, due to the blast action discharge operation, it will provide better condensate draining out of the tracer pockets.

Thermostatic steam traps should be selected for winterising steam tracing systems which discharge at a sub-cooled temperature. The vapour pressure steam trap is somewhat more resistant to fouling and pressure/temperature changes, whereas the bimetallic steam trap has more resistance to water hammer.

Steam traps shall be selected according to their designed duty. Normally the leak rates of steam traps are related to their capacity rather than their duty. A steam trap with too much capacity will give a higher leak rate than a steam trap of the correct capacity for the same

duty.

The inverted bucket type steam trap is the best choice. It combines good operation with low maintenance.

Due to the difference in working principles, only one type of steam trap per header shall be used.

Steam traps should also be capable of removing air and other incondensable gases from the steam.

Each tracer shall have its own steam trap, including multiple tracers on a single process line.

The steam trap shall be located at the lowest point of the tracer so that condensate can reach it freely. The steam trap shall preferably be an integral part of the collecting manifold.

To minimise fouling, a strainer should be installed upstream of the steam trap (this is particularly the case in winterising systems).

3.3.4 Condensate return

For a proper heat exchange of the tracers to the process pipe it is important for the condensate to be removed properly. Further it is also important to avoid water hammer.

For energy conservation, steam traps should discharge into a closed system. The steam traps should be grouped together on a collecting manifold.

The collecting manifold should be vertical with a valved drain connection at the lowest point.

The steam trap back pressure shall not exceed 50% of the upstream pressure.

Steam flashing and water hammer will seriously degrade condensate lines which are too small. Condensate lines of systems which discharge condensate at saturated steam temperatures shall be sized to handle the flash steam content, not just the condensate. The condensate volume after flashing is normally so small that it may be ignored.

There shall be no extra steam trap after a collection manifold.

Open discharges from steam traps (only at locations without a condensate collecting system) shall be located so that steam clouds formed at the trap discharge do not hamper operation/maintenance activities in the vicinity of the trap. The condensate should discharge in a suitable drain or soakaway.

Open steam trap discharges shall be located away from doors, windows and air intakes. In cold areas, icing-up of personnel access areas shall be avoided.

Steam pipes shall not discharge condensate into sewer systems but instead shall run to a safe location such as collecting condensate pits, contaminated water rundown systems, gravel pits, gullies, etc., and shall be combined as far as practical.

Condensate pipes in areas where frost can occur shall be provided with protective heating or insulation.

4. DOCUMENTS

4.1 PROCESS ENGINEERING FLOW SCHEMES

Steam tracing and jacketing shall be indicated according to DEP 31.10.03.10-Gen.

4.2 STEAM TRACING/JACKETING PLAN DRAWINGS

All tracing steam and condensate headers/sub-headers, steam supply lines from the tracing steam header to the distribution manifolds, condensate return lines from the collecting manifolds to the tracing condensate header, distribution manifolds and collecting manifolds, shall be indicated in full detail on the tracing/jacketing plan drawings .

Tracers shall be shown, indicating the connection to the lead and tail, the expansion loops with related fixed points, the break flanges at break points in process piping, etc.

Jacketing shall be shown, indicating the connection to lead and tail.

The Contractor shall develop typical sketches such as expansion loops in tracers and tracing details for valves, strainers, level gauges and pumps.

4.3 ISOMETRIC DRAWINGS

The isometrics of the process lines which are steam traced shall show the tracers as dotted lines. Leads and tails shall make reference to relevant distribution and collecting manifold numbers.

The isometrics of the jacketed process lines shall provide all details for the process line and jacketing. Leads and tails shall make reference to relevant distribution and collecting manifolds.

Isometric drawings shall be made of the tracing steam and condensate headers and sub headers, the steam distribution lines from the tracing steam header to the distribution manifold, the condensate return lines from the collecting manifold to the tracing condensate header, the distribution manifolds and the collecting manifolds. Material of these isometrics should be covered in the bill of material for piping.

Steam tracing material not covered by the above-mentioned isometrics (leads, tracers and tails) shall be covered in the bill of material for steam tracing. The procurement of this material shall be based on the steam tracing plan drawings.

4.4 TRACER REFERENCE LIST

For each tracing/jacketing system a tracer reference list shall be made. The tracer reference list shall show as a minimum, in the sequence of the distribution manifold numbers:

- the traced process item numbers (line, instrument, pump);
- the receiving collecting manifold number;
- the steam tracing/jacketing plan drawing number.

4.5 TAGGING

Each DM and CM shall have a tag showing its manifold number.

Each lead shall have a tag showing the traced process item number (line, instrument, pump number) and receiving CM number.

Each tail shall have a tag showing the traced process item number (line, instrument, pump number) and the supplying DM number.

5. MATERIALS AND FABRICATION

5.1 MATERIAL SELECTION

All materials of the system shall be specified by the Contractor or Principal and indicated in the piping systems specification of the project. Otherwise all construction materials shall be selected according to DEP 30.10.02.11-Gen.

All materials for pressure parts shall be delivered with certificates according to ISO 10474 type 3.1.B.

5.2 PIPING

All piping shall be designed, fabricated, erected, inspected and tested in accordance with ASME B31.3 and DEP 31.38.01.11-Gen. and DEP 31.38.01.31-Gen.

5.3 WELDED JOINTS

Joints shall be made by welding wherever possible, unless otherwise specified; all tube ends and pipework shall be suitably prepared for welding.

Welding details shall be in accordance with ASME B31.3.

5.4 FLANGED JOINTS

All flanges shall be in accordance with ASME B16.5.

Bolts and nuts for pipe flanges shall have UNC thread.

Gaskets shall be asbestos free.

6. APPLICATION

6.1 INSTALLATION

For bending of tracers see DEP 31.38.01.31-Gen.

For typical installation details of tracers, especially around valves and pipe supports, refer to appendices 2, 4, 5, 6 and 7.

Any damaged paint of process piping shall be touched up before attaching the tracers to the process pipes. At weld locations, paintwork of the process pipes shall be protected.

Tracers shall be attached to the process pipes by stainless steel band fasteners in such a way that the tracers are in full contact with the process pipes but can move along the process pipes to cope with differential expansion. Only at the predetermined fixed points shall the tracer be fixed so that the tracer cannot move along the process pipe.

The maximum fastener interval shall be 1000 mm.

To avoid expansion problems and hot spots, tracers shall not be welded to the process pipe.

Where blanket insulation is used, measures shall be taken to prevent fragments of insulation getting into the airspace between the tracer and the process pipe. This can be achieved by installing aluminium channels over the tracer before application of the insulation (see Appendix 2.)

The tracer expansion loops shall follow the contours of the process pipe as much as possible.

Wherever possible, the leads and tails shall be routed close together, allowing combined insulation and supporting.

The constant slope in the tracer shall be maintained as far as possible during coil wound tracing of items (e.g. valves, strainers, level gauges and pumps).

During installation of the tracing system, ingress of dirt shall be prevented. The system shall be flushed before the installation of the steam traps.

6.2 INSPECTION AND TESTING

Inspection may be carried out after protective coatings have been applied.

Before application of the insulation, the steam trace system shall be hydrostatically tested.

For the leads, tracers and tails, an initial service leak test is sufficient.

Both pressure and leakage tests shall be in accordance with ASME B31.3.

After cleaning, all systems shall be pressurised with steam, and checked for leakages and proper functioning of steam traps.

All material and test certificates shall be available and recorded in accordance with local requirements.

6.3 COMMISSIONING

Steam trace systems shall be commissioned slowly enough to:

- allow steam to condense before it reaches the traps;
- allow air to be vented through the traps;
- minimise the risk of water hammer;
- minimise insulation damage due to differential expansion between tracer and process pipe.

7. PAINTING, PRESERVATION AND INSULATION

7.1 PAINTING

Steam supply and distribution and collecting manifolds shall be painted according to DEP 30.48.00.31-Gen.

Tracers shall not be painted. However, for winterising tracing systems tracers shall be painted in accordance with DEP 30.48.00.31-Gen.

7.2 INSULATION

Normally, insulation is not included in the scope of supply of the manufacturer/supplier.

All traced piping and headers shall be insulated. Steam traps shall not be insulated, with the exception of mechanical types.

Insulation and personnel protection shall comply with DEP 30.46.00.31- Gen.

8. MAINTENANCE

For sustained energy savings, steam tracing systems require regular maintenance.

Systems shall be visually checked on a regular basis. Immediate corrective action shall be taken if insulation is found to be faulty. Leaking steam traps, valves and flanges shall be repaired as soon as possible.

Leaks to the outside are easy to detect, but the detection of leaking or blocked steam traps in closed systems is more difficult.

Temperature measurements close to steam traps can reveal blocked or completely passing steam traps, but small leaks cannot be discovered by this method.

Sound measurement instruments (stethoscope, ultrasonic) used by experienced personnel can detect small leaks in steam traps.

Infra-red thermography is often very effective in determining the overall condition and operation of traced systems.

After maintenance work has been carried out, steam traps with open inverted buckets shall be filled with water before re-installation.

Leaking and malfunctioning steam traps will increase maintenance costs substantially. It is therefore recommended to set up a scheme for the regular maintenance and replacement of steam traps. With this scheme and records, proper conditioning monitoring can be established.

9. REFERENCES

In this DEP, reference is made to the following publications:

Note Unless specifically designated by date, the latest edition of each publication shall be used, together with any amendments/supplements/revisions thereto.

SHELL STANDARDS

Index to DEP publications and standard specifications	DEP 00.00.05.05-Gen.
Metallic materials - Selected standards	DEP 30.10.02.11-Gen.
Thermal insulation for hot services	DEP 30.46.00.31-Gen.
Painting and coating of new equipment	DEP 30.48.00.31-Gen.
Symbols and identification - Mechanical	DEP 31.10.03.10-Gen.
Piping - General requirements	DEP 31.38.01.11-Gen.
Shop and field fabrication of steel piping	DEP 31.38.01.31-Gen.
Instrument impulse lines	DEP 32.37.10.11-Gen.
Electrical heat tracing	DEP 33.68.30.32-Gen.

AMERICAN STANDARDS

Pipe flanges and flanged fittings	ASME B16.5
Chemical plant and petroleum refinery piping	ASME B31.3

Issued by
American Society of Mechanical Engineers,
345 East 47th Street,
New York, NY 10017, USA

BRITISH STANDARDS

Unfired fusion welded pressure vessels	BS 5500 (1997 Edition)

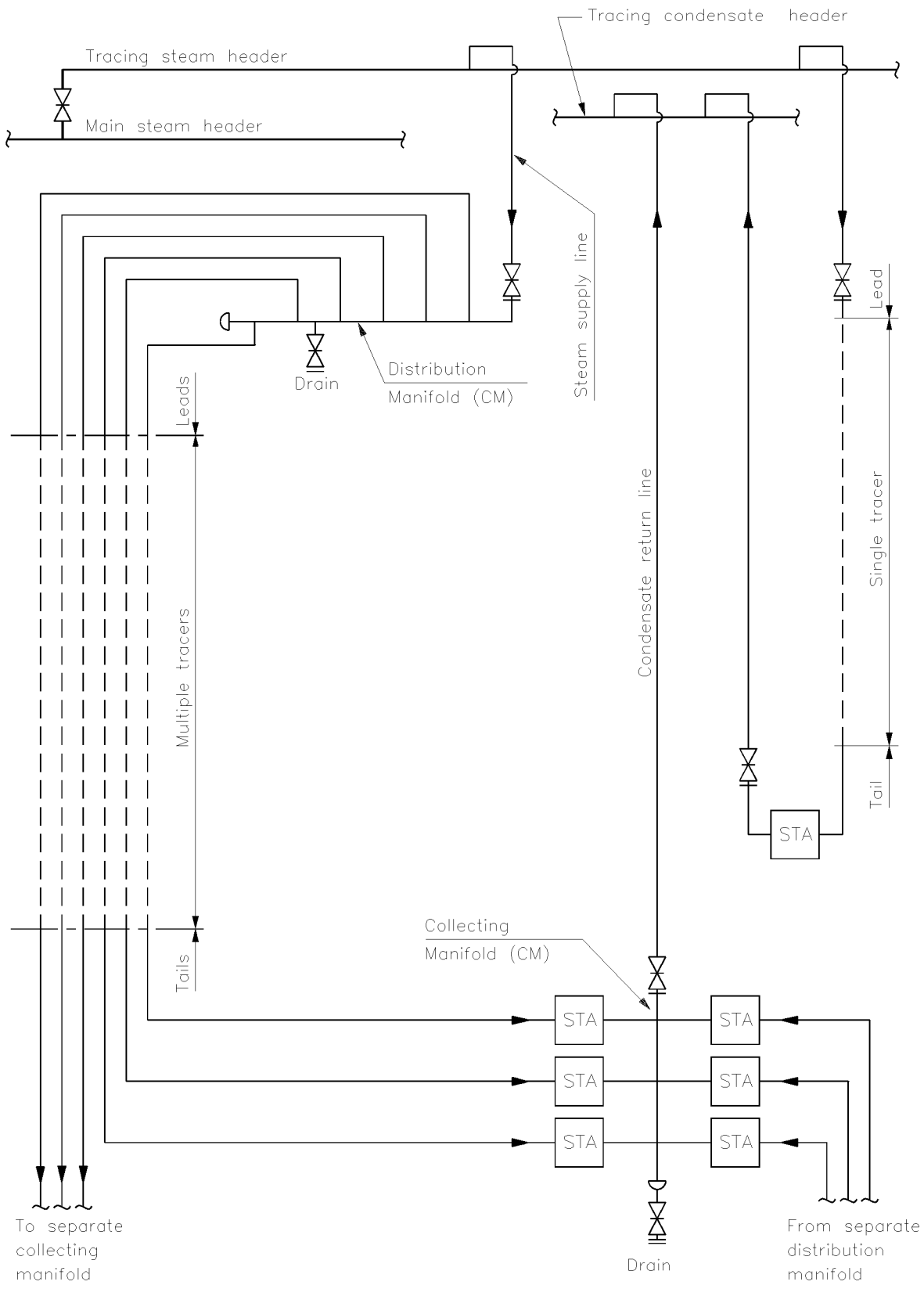
INTERNATIONAL STANDARDS

Automatic steam traps - classification	ISO 6704
Steel and steel products, inspection documents	ISO 10474

Issued by:
International Organization for Standardization
1, rue de Varembé
CH-1211 Genève 20
Switzerland.

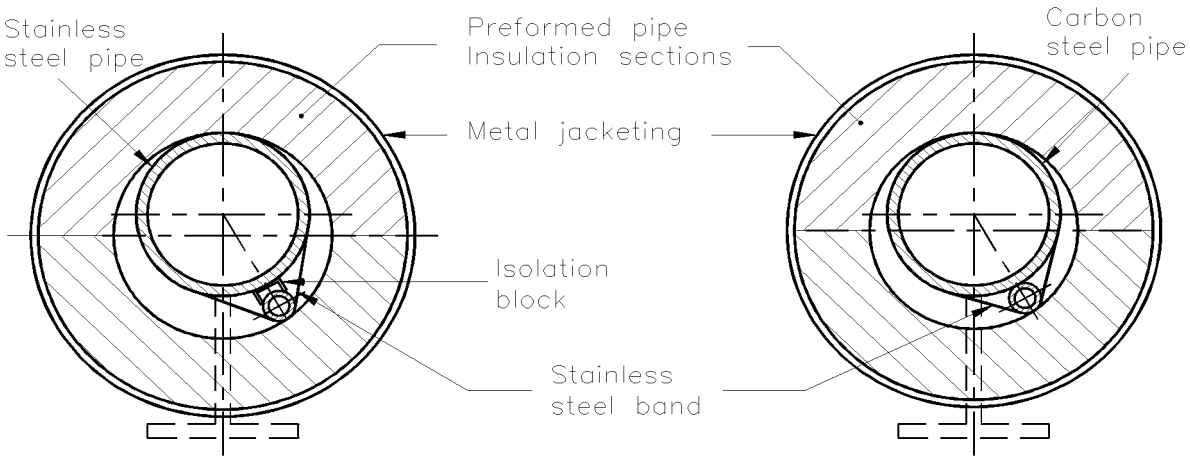
Copies can also be obtained from national standards organizations.

APPENDIX 1 TYPICAL ARRANGEMENT OF A STEAM TRACING SYSTEM

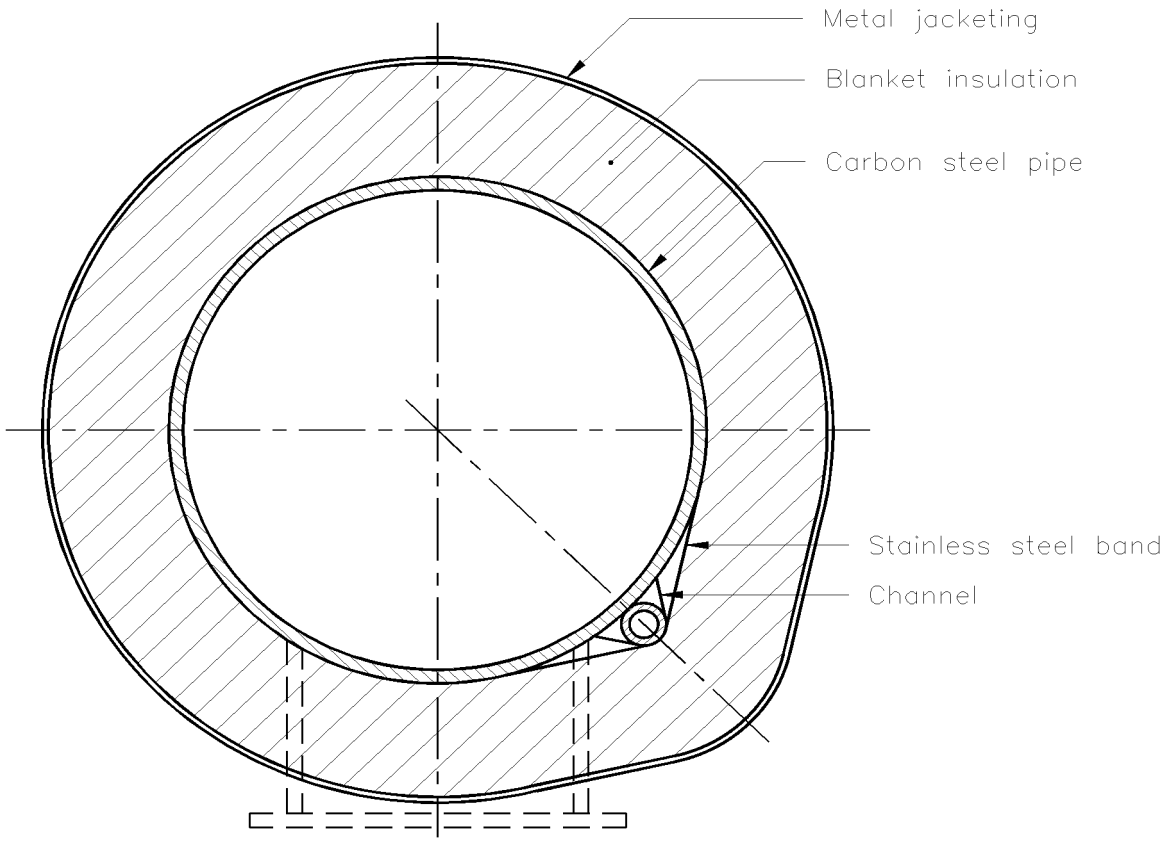


APPENDIX 2 TRACER ATTACHMENT

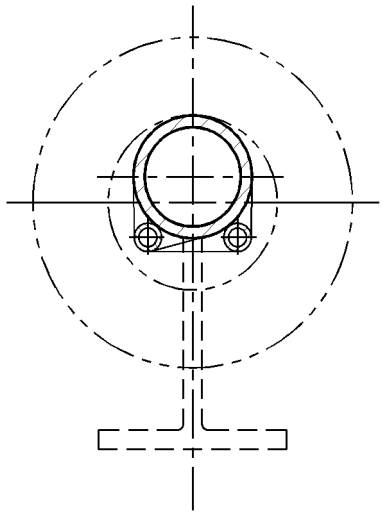
Note: Insulation and pipe supports are indicative only.

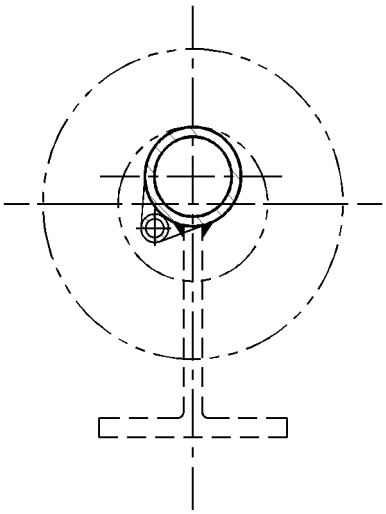


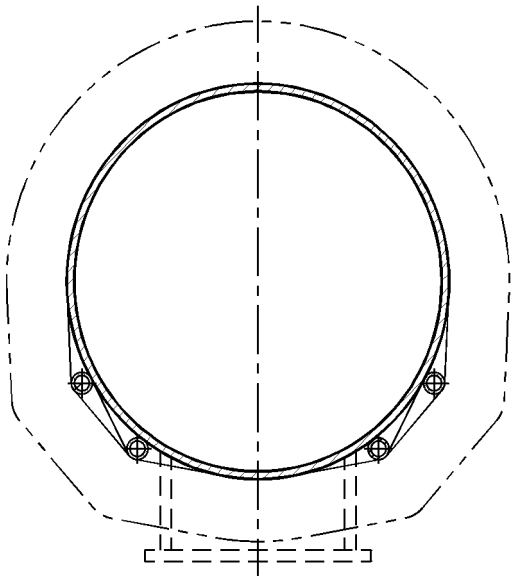
For pipe dia ≤ DN 300

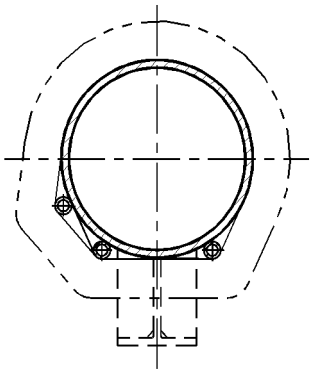


For pipe dia ≥ DN 350



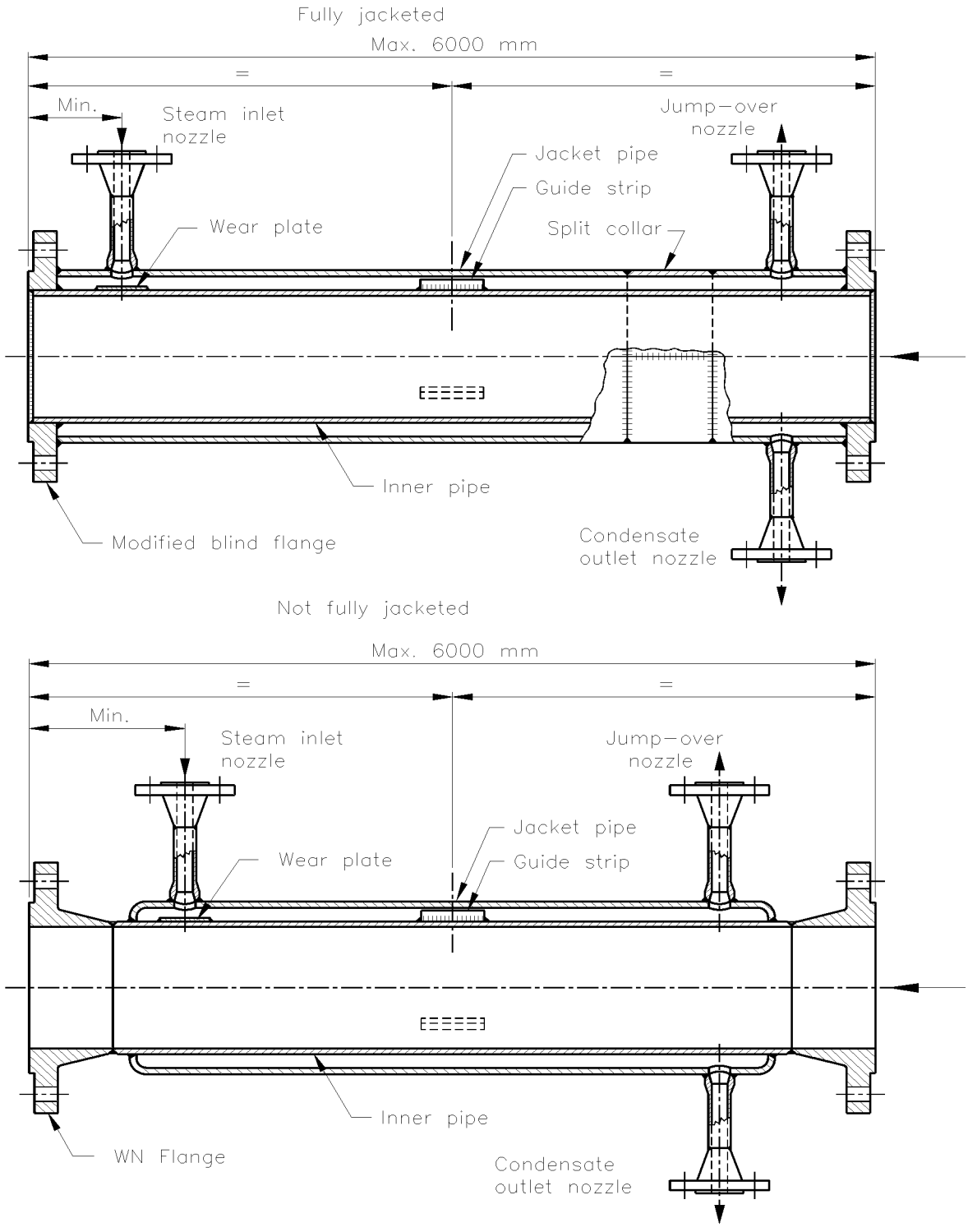




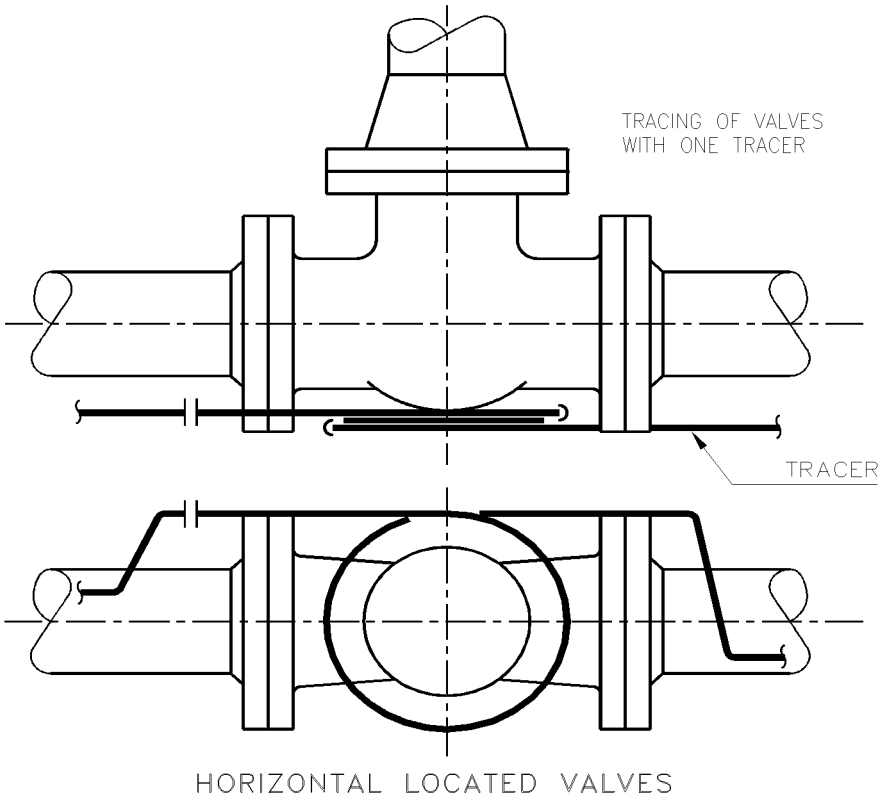


NOTE: Insulation and pipe supports are indicative only.

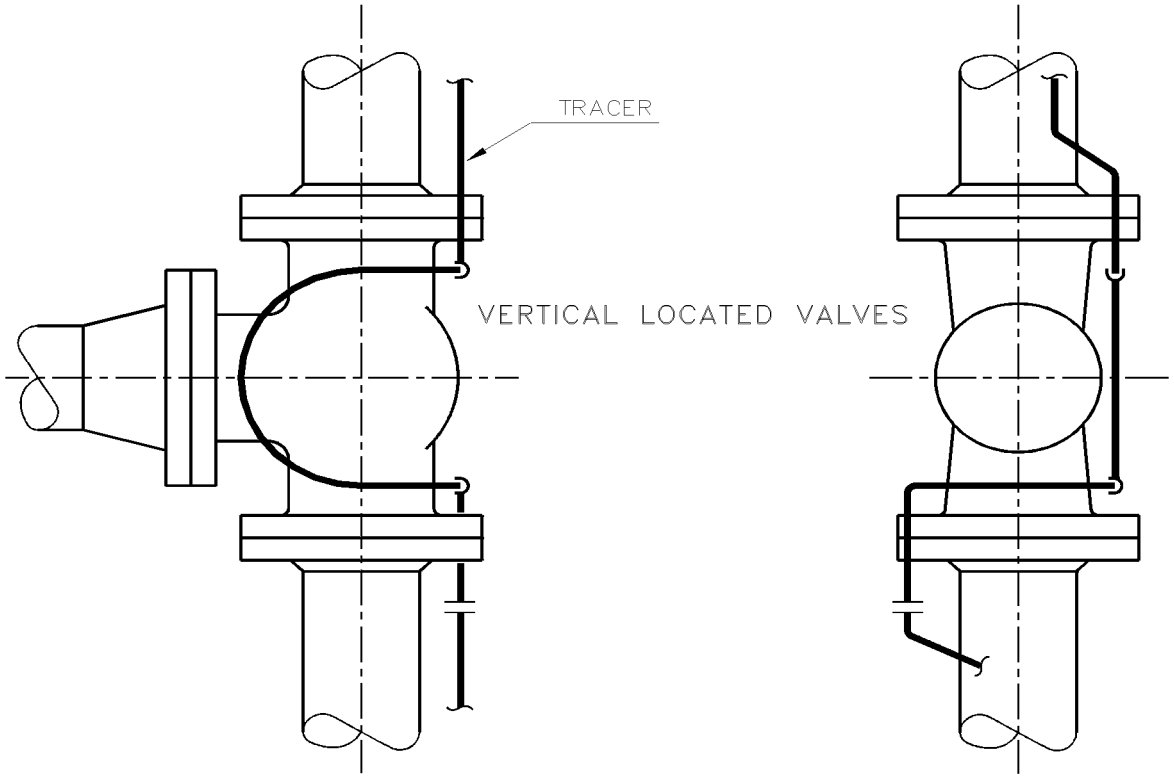
APPENDIX 3 STEAM JACKETING



APPENDIX 4 TRACING OF SMALL BORE VALVES

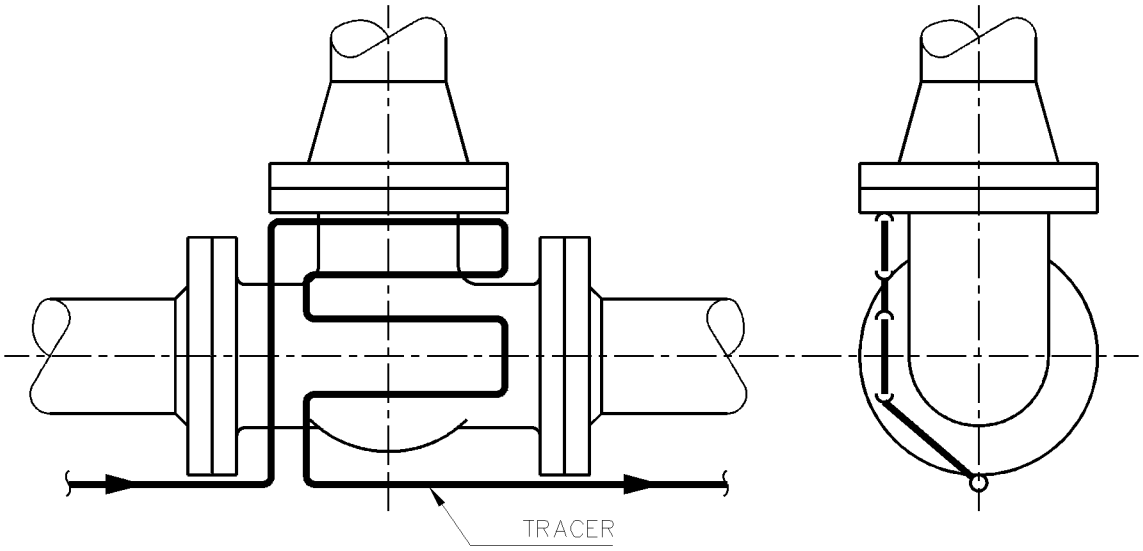


HORIZONTAL LOCATED VALVES

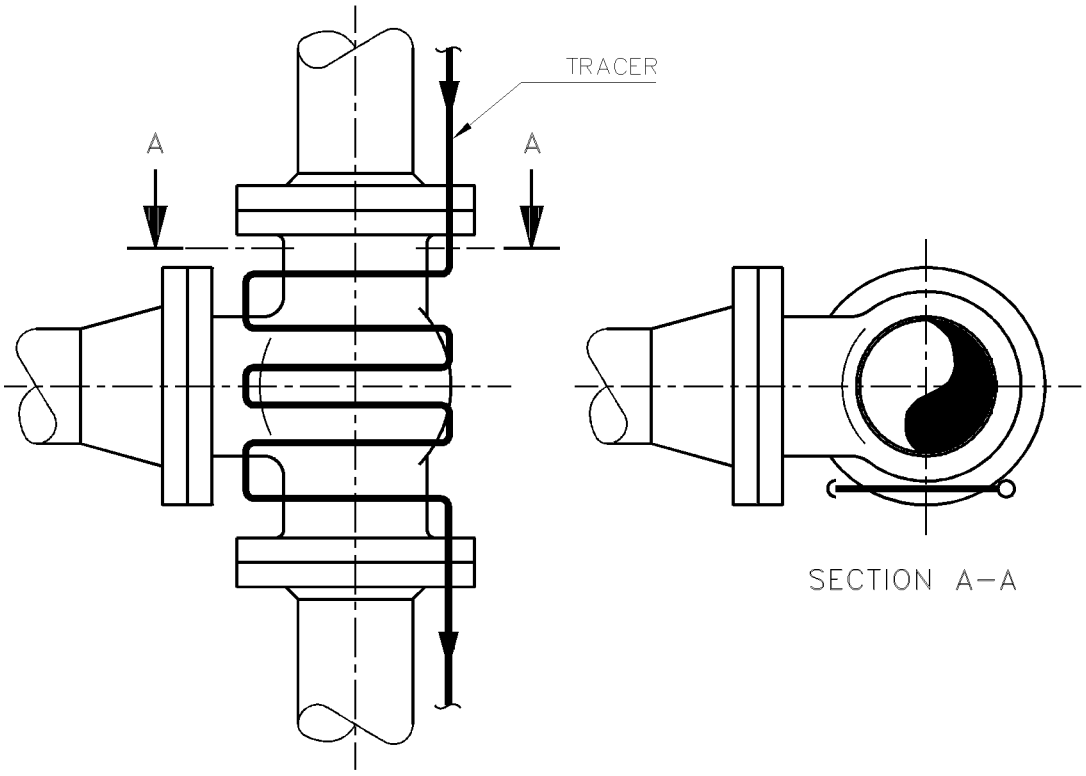


VERTICAL LOCATED VALVES

APPENDIX 5 TRACING OF LARGE BORE VALVES



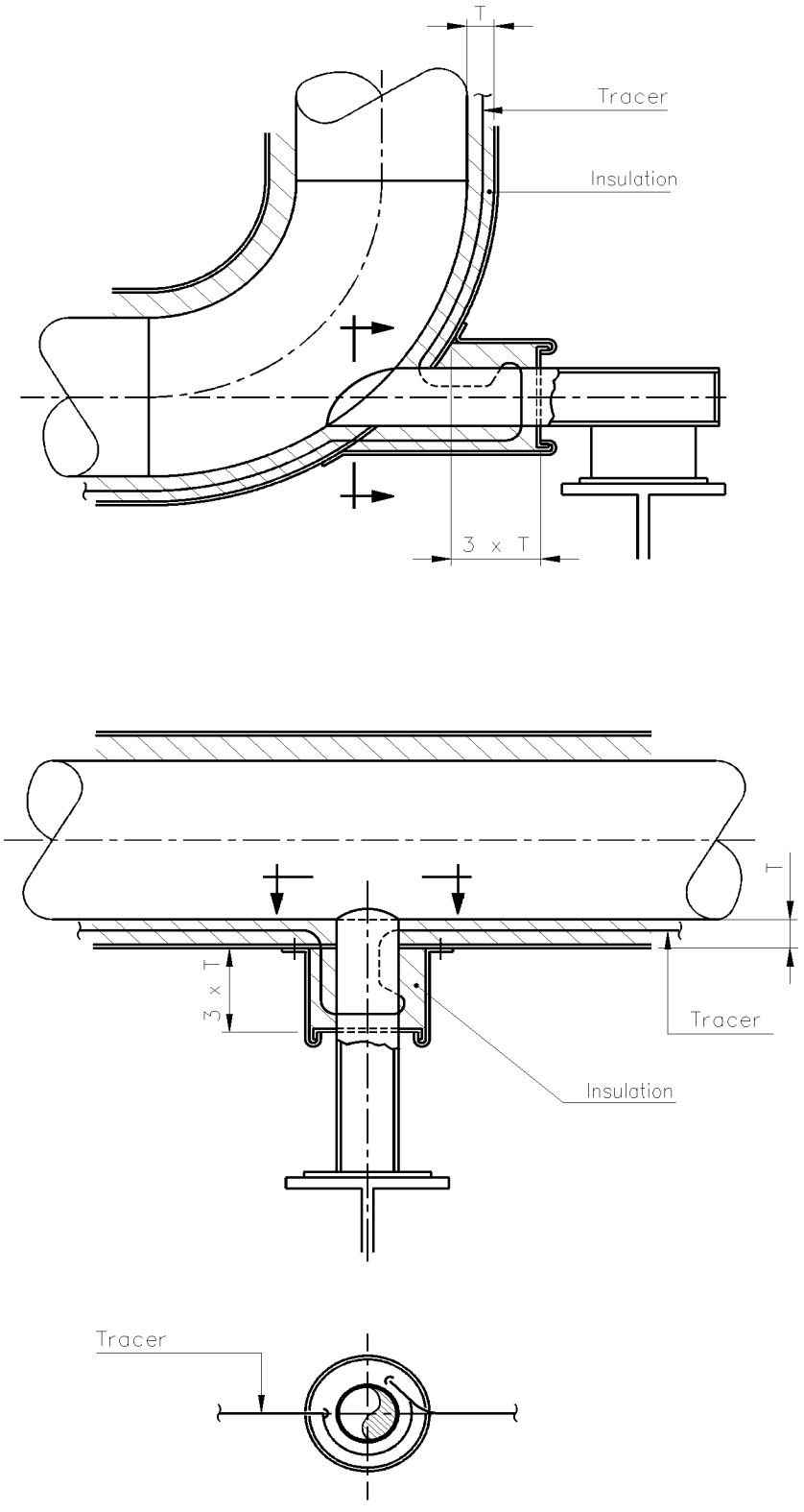
HORIZONTAL LOCATED VALVES



SECTION A–A

VERTICAL LOCATED VALVES

APPENDIX 6 TRACING OF TRUNNION SUPPORTS



Note: Insulation is indicative only.