

DEP SPECIFICATION

PROTECTIVE STEAM HEATING OF PIPING SYSTEMS (NON-ELECTRICAL)

DEP 31.38.30.11-Gen.

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DESIGN AND ENGINEERING PRACTICE



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1. INTRODUCTION

1.1 SCOPE

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

Distribution Manifolds for steam tracers, steam tracing, steam and heat transfer fluid jacketing and Collection Manifolds for steam tracers are included in the scope of this DEP.

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

Design requirements for main steam distribution systems and main condensate return 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.

This DEP is a revision of an earlier DEP of the same number, dated December 1997, including DEP Circular 51/01.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

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This DEP is intended for use in facilities related to oil and gas production, gas handling, oil refining, chemical processing, gasification, distribution and supply/marketing. This DEP may also be applied in other similar facilities.

When DEPs are applied, a Management of Change (MOC) process shall be implemented; this is of particular importance when existing facilities are to be modified.

If national and/or local regulations exist in which some of the requirements could 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 with regards to the 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, the objective being to obtain agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party that 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 that manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party that initiates the project and ultimately pays for it. 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

Term	Definition
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).

1.5 SUMMARY OF MAIN CHANGES

This DEP is a revision of the DEP of the same number dated December 1997, including Circular 51/01. The following are the main, non-editorial changes.

Section	Change
Title	Changed to reflect other heating media as well as steam.
All Sections	US customary units incorporated for pipe sizes, distance, pressure and temperature
2.	Changed to reflect other heating media as well as steam.
3.1	Modified steam tracing requirement for caustic soda
3.1	For Winterising, section 3.3 created and all relevant details of winterising mentioned 3.1 transferred to 3.3
3.1	Alternative heat requirements given for calculating the number and size of tracers.
3.1	Requirement of additional tracer length for inline piping components, pumps mentioned.
3.2	Title of this section changed to "Jacketed Piping". Recommended sizes for jacketed piping added as table-3. For jacketed piping system, detailed design reference to additional standards has been updated.
3.2	Introduced liquid heat fluid jacketed piping systems.
3.2	Introduced bolt-on jackets
3.3	New section on winterising introduced
3.4.3	Updated guidance on selection of steam traps
4.4	Updated "Tracer Reference List"
5.1	Introduced "Tracers made of tubing" as an alternative approach to "Tracers made of pipe". Certification requirements updated.
5.5	Added tubing joints.
6.1	Introduced Installation requirements for "Tracers made of tubing". Added requirements regarding attachment of tracers without over tightening.

Section	Change
6.2	Added final inspection of tracing and performance check of steam traps. Updated testing requirements.
6.3	Added "Insulation material of pre-insulated tracer tubing shall be chloride-free".
9. References	Reference standards updated
Appendix-3	Updated steam jacketing typical arrangement drawing
Appendix-4	New appendix for liquid heating fluid jacketed piping.

1.6 COMMENTS ON THIS DEP

Comments on this DEP may be sent to the Administrator at standards@shell.com, using the DEP Feedback Form. The DEP Feedback Form can be found on the main page of "DEPs on the Web", available through the Global Technical Standards web portal <http://www.shell.com/standards> and on the main page of the DEPs DVD-ROM.

1.7 DUAL UNITS

This DEP contains both the International System (SI) units, as well as the corresponding US Customary (USC) units, which are given following the SI units in brackets. When agreed by the Principal, the indicated USC values/units may be used.

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:

a) steam tracing	• permanent heating • winterising
b) steam / heat transfer fluid jacketing	• fully jacketed • partially jacketed

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

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).

In steam traced pipes in Sodium Hydroxide service (caustic soda) hot spots due to direct wall-to-wall contact with steam tracing shall be avoided in order to avoid sodium hydroxide embrittlement (a type of stress corrosion) which is strongly influenced by temperature by fitting spacers (ceramic, glass fibre or filled phenolic resin).

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

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.

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 Table 1 (metric units) and Table 2 (USC units):

Table 1 Number and size of tracers (Metric units)

Type of fluid	Process pipe size (DN)					
	Up to 40	50 - 200	250 - 300	350 - 450	500	600
	Number and size (DN / Tube size) of tracers					
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°C 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

Table 2 Number and size of tracers (US customary units)

Type of fluid	Process pipe size (NPS)					
	Up to 1 ½	2 – 8	10 – 12	14 – 18	20	24
	Number and size (NPS / Tube size) of tracers					
Solidification below 75°F	1 x ½	1 x ½	1 x ½	1 x ¾	1 x ¾	1 x ¾
Solidification between 75°F and 150°F	1 x ½	1 x ½	1 x ½	1 x ¾	2 x ½	2 x ¾
Solidification between 150°F and 210°F (Note 1)	1 x ½	2 x ½	3 x ½	3 x ¾	4 x ¾	4 x ¾

- 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 (NPS ½) 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.
 3. For steam tracing applications operating in areas with temperatures below minus 10°C (14 F) the heat loss shall be calculated. If required more tracers shall be applied.
 4. For steam tracing application in warm climates the heat losses should be calculated because it may be possible to reduce the number of tracers.

For the above table, the parameters used are:

- LP Steam 3.5 barg (50 psig), 150°C (300°F);
- 50 mm (2 in) mineral wool insulation for lines up to and including DN 100 (NPS 4);
- 90 mm (3½ in) mineral wool insulation for lines DN 150 to DN 600 (NPS 6 to NPS 24);
- air temperature = minus 10°C (14°F);
- wind velocity = 10 m/s (33 ft/s).

Tracers shall not be provided with branches.

As an alternative to the above mentioned guidance on the number and size of tracers, steam tracing systems can be designed to supply the largest of the following heat requirements:

- a. For lines DN 25 (NPS 1) and smaller, the theoretical heat requirement shall be multiplied with a factor 1.5 to calculate the actual heat required to maintain the minimum specified temperature.
- b. For lines over DN 25 (NPS 1), vessels, and tanks, the theoretical heat requirement shall be multiplied with a factor 1.25 to calculate the actual heat required to maintain the minimum specified temperature.
- c. For piping thaw-out and additional heat-up requirements, the theoretical heat requirement shall be used to calculate the heat required.
 - Unless otherwise specified, design time for piping thaw-out shall be a maximum of 6 hours.

- Unless otherwise specified, the design temperature range for additional heat-up shall be a temperature differential of 48.5°C (87°F).
- If the above two design criteria produce unreasonable requirements such as a large number of tracers, the Principal shall be consulted.
- Heat requirements for piping thaw-out and additional heat-up shall be based on no product flowing in the line.

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 piping systems and in-line equipment such as strainers. 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 (10 ft).

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 (65 ft) intervals. At line flanges the tracer shall also have flanges to permit dismantling.

The length of tracers shall not exceed the values specified in Table 3.

Table 3 Maximum length of tracers

Steam pressure	Tracer size	Maximum length of tracer
3.5 barg (50 psig)	DN 15 (NPS ½)	40 m (130 ft)
	DN 20 (NPS ¾)	50 m (165 ft)
17.5 barg (250 psig)	DN 15 (NPS ½)	60 m (195 ft)
	DN 20 (NPS ¾)	100 m (330 ft)

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 6 and 7).

Tracing at trunnion support locations is indicated in (Appendix 6).

For inline piping components and pipe supports, additional steam tracer length shall be considered. At larger-than-line objects such as pumps and control valves, design of tracers shall consider the use of heat transfer cement or parallel tracers in lieu of extra tracer length.

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