MANUAL

INSTRUMENT IMPULSE LINES

DEP 32.37.10.11-Gen.

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(DEP Circulars 33/97 and 46/99 have been incorporated)

DESIGN AND ENGINEERING PRACTICE

USED BY

COMPANIES OF THE ROYAL DUTCH/SHELL GROUP

PREFACE

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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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1. INTRODUCTION

1.1 SCOPE

This DEP is a revision of the previous publication of the same number and title dated July 1987. It specifies the minimum requirements for impulse lines connecting instruments to process equipment and gives guidance on how these requirements can be met.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

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

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

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 combination of requirements will be acceptable as regards safety, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this document 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 document as closely as possible.

1.3 DEFINITIONS

For the purposes of this DEP, the following definitions apply:

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 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

The terms **Electrical Engineering** and **Mechanical Engineering** are used in various parts of this DEP (sections 3, 6.2, 7.2 and 7.3) to identify activities or materials which are considered outside the responsibility of the typical Instrument Engineering discipline serving a project. It is not intended to preclude a particular project from reassigning responsibilities, but primarily to identify areas which may otherwise be overlooked in planning.

1.4 CROSS-REFERENCES

Where cross-references are made, the number of the section or sub-section referred to is shown in brackets.

All publications referred to in this document are listed in (9).

2. GENERAL

For **general applications**, the impulse lines shall be made up from stainless steel tubing and stainless steel compression fittings as described in (4).

Metric tubing and compression fittings (10 mm OD) should be used for new projects. The application of imperial sized tubing and related compression fittings ($^3/_8$ inch OD) requires the approval of the Principal and should be restricted to locations which have standardized on imperial sizes.

It shall be ensured that $^3/_8$ inch OD tubing is not used in combination with 10 mm compression fittings because this will result in unreliable joints.

For **special applications**, e.g. for corrosive or toxic duties, etc., other materials and/or additional provisions are required, see (5).

The impulse lines described in this specification shall be suitable for use at pressure ratings up to 413 bar (ga) at 38 °C. For limitations, see Appendix 1.

Based on the specifications given in sections 4 and 5, and the additional requirements for sealing, purging and instrument protection given in sections 6 and 7, the best arrangement for each instrument shall be determined and shown in detail on a drawing, see (8) for further information.

Amended per Circular 46/99

For guidance on the location of instruments and instrument process connections including their accessibility, refer to DEP 32.31.00.32-Gen.

3. INSTRUMENT PROCESS CONNECTIONS

Amended per Circular 33/97

Process connections shall, wherever possible, terminate in a DN 15 flange.

For close coupled pressure gauges, use shall be made of a flanged gauge block, which shall be in accordance with MESC 60.98.55/201.

Lapped-joint tube adapters should be applied for instruments mounted remotely from the process connection.

The flange facing finish of the gauge blocks and the lapped-joint tube adaptors shall be in accordance with ASME/ANSI B16.5.

Main isolating valves, cover flanges of the tube adapters, gaskets and bolts are the responsibility of Mechanical Engineering.

For certain applications, the Principal may specify a threaded connection, which shall then be parallel threaded in accordance with Standard Drawing S 37.808.

NPT threaded connections should only be used with the approval of the Principal.

4. GENERAL SPECIFICATION FOR IMPULSE LINES

4.1 SPECIFICATION OF COMPONENTS

For general applications, with respect to piping classes for carbon steel, low alloy steel, stainless steel and aluminium alloys, the instrument impulse lines shall consist of AISI 316 stainless steel components, i.e. 10 mm OD x 1.5 mm wall thickness tubing and compression fittings.

Impulse line components shall comply with the MESC specifications given on the Standard Forms DEP 32.37.02.81-Gen. and, when applicable, DEP 32.37.02.82-Gen. These currently cover applications for pressures up to 413 bar (ga).

However, austenitic stainless steel impulse lines (including insulated tubing) which are exposed to temperatures above 60 °C, are vulnerable to chloride stress corrosion. Impulse and steam tracer tubing, installed under such conditions shall be constructed from any of the following materials:

- ASTM B423 alloy (UNS N08825) tubing, e.g. Incoloy 825 or Nicrofer 4221
- ASTM B668 alloy (UNS N08028) tubing, e.g. Sanicro 28
- UNS S 312 254 SMO.

All of the above tubing can be used in combination with AISI Type 316 stainless steel compression fittings. The hardness of the high nickel alloy tubing shall be within the range of 77-83 HRB.

The Principal's approval for the materials selected shall be obtained.

For special applications, refer to section 5.

All components, i.e. the tubing and compression fittings, shall be suitable for use at 413 bar (ga) at 38 °C. For pressure ratings at temperatures higher than 38 °C, see Appendix 1.

Amended per Circular 46/99

NOTE : The reliable application of compression fittings require that:

- the compression fittings are of the make, type and composition as specified for the project by the Principal and of which all parts of the fitting are made by one manufacturer;
- the tubing conforms to the specification supplied by the Principal;
- the fittings and tubing are installed by skilled personnel, strictly in accordance with the manufacturer's instructions;

In addition to the main process isolating valve, manifolds or gauge blocks shall have their own integral isolating facilities. The preferred connection for the process and vent/drain ports on the block shall be threaded G ¼ inch and equipped with compression fittings of make, type and composition specified by the Principal. The soft annealed metal ring between the body of the compression fitting and the female port in the block, shall be in accordance with Standard Drawing S 37.808. The use of NPT threaded connections requires the approval of the Principal.

Refer to MESC 60.98.xx for manifold blocks, gauge blocks and related components.

Gauge blocks shall be provided with a ½ inch female threaded gauge adapter. The type of thread for the pressure gauge (½ inch NPT or G ½ inch) shall be specified by the Principal.

For the dimensions of G ½ inch parallel threaded pressure gauge connections, refer to Standard Drawing S 37.809.

Subject to the approval of the Principal, a combined manifold may be used for close-coupled pressure gauges. This manifold consists of a mechanically approved first isolating valve, a vent/drain facility and an additional instrument isolating valve. This manifold thereby replaces the separate mechanical isolating valve and the instrument gauge block.

Impulse lines branching off to more than one instrument shall have individual isolating facilities for each instrument.

All instrument impulse lines shall have facilities for venting or draining the instrument. The

vent or drain valves shall be provided with a device to prevent tampering.

The internal diameter of the female port of the tamper proof valve head assembly and the outside diameter of the anti-tamper key shall be strictly in accordance with the requirements of the relevant MESC specification.

A length of tubing, approx. 300 mm, shall be fitted to the vent or drain connections and directed downwards. See also (5.8).

4.2 MOUNTING ARRANGEMENTS

The manifold block, which forms part of the impulse line arrangement, shall be bolted to a mounting plate, which shall be as shown on Standard Drawing S 37.813 (L-shape) or S 37.814 (rectangular).

If specified by the Principal, to provide easy access to the terminals the test connection box for electronic transmitters, or the small junction box for smart transmitters, shall be mounted at the front side of the mounting plate.

Protection of the instrument against direct sun radiation (mainly required for tropical and desert climates) shall be provided by a protective shade, which shall also be bolted onto the mounting plate.

Selection of the type of mounting plate depends upon the various components required:

L-shape:
- When a sun shade is required;
- When a local test box or junction box is required (in combination with a requirement for a protective housing around the transmitter body).

Rectangular:
- All others.

Process tappings for impulse piping on horizontal liquid, gas and steam lines shall normally be on the top. The advantage of this arrangement is that the small process connections are less likely to be blocked by dirt, scaling from the process lines etc.

For liquid measurements, this arrangement may cause gas to collect in the impulse lines.This can be reduced by minimising the difference in elevation between the top part of the impulse line and its process connection.

Close coupled transmitters in liquid service may be mounted above the process tapping(s), provided the distance between process tapping and inlet connection to the transmitter is kept as short as possible.

Remote mounted transmitters in liquid service shall also have their process tappings on top, but the transmitter shall be mounted below the tappings.

When a liquid contains dissolved gases, the impulse lines shall slope downwards to the instrument so that gas is automatically vented back into the process. In such cases the instrument should be mounted in a vertical line. If this is not possible, the process tappings should be installed at the bottom of the horizontal line.

Typical examples of both liquid, gas and steam applications are shown on Standard Forms DEP 32.37.02.81-Gen. (Metric) and DEP 32.37.02.82-Gen. (Imperial)

For process temperatures between -100 °C and +200 °C, close-coupled pressure gauges may be supported by the process nozzle and its gauge block. For all other installations, adequate supports shall be selected.

The use of line-mounting type supports requires the approval of the Principal. They may be considered for close-coupled installations but shall not be applied on:
- process line sizes smaller than DN 100;
- process piping material other than carbon steel;
- insulated process piping;
- vibrating service.

The supports shall be listed on sheets such as the Standard Forms DEP 32.37.02.81-Gen. and DEP 32.37.02.82-Gen., using the codes given therein.

The gauge blocks and mounting plates have facilities for installing nameplates, which shall

be in accordance with DEP 32.37.10.34-Gen. Prefabricated mounting arrangements should be provided with engraved nameplates, attached by stainless steel screws or stainless steel pop rivets.

Instruments connected to process pipes which vibrate heavily shall be installed on independent supports, with the impulse lines arranged sufficiently flexible to take up the vibration and to prevent the impulse lines from vibrating.

Instrument impulse lines shall be as short as possible. The number of joints in the impulse lines shall be kept to a minimum. For straight lengths up to a maximum of 1 m the tubing is self-supporting, for longer lengths the tubing shall be supported at approximately 1 m intervals. Thermally insulating spacer material shall be applied to separate the tubing from the supports. Impulse lines shall be grouped closely together. Seal pots etc. shall be properly supported to prevent stresses on compression fittings and damage to the tubing.

For instruments which are remotely located from the instrument process connection, the impulse lines shall be so arranged that any movement, e.g. thermal expansion, will not exert an excessive force on any connection. Instrument impulse lines which are subject to excessive movement shall be provided with expansion loops.

NOTE : Special attention shall be given to longer impulse lines running horizontally. This type of installation shall be avoided to reduce the possibility of mechanical damage or the formation of "pockets" which may result in false readings.

Typical examples of installations provided with expansion loops and installations on vibrating service are shown in Standard Forms DEP 32.37.02.81-Gen. and DEP 32.37.02.82-Gen.

5. SPECIAL APPLICATIONS

5.1 GENERAL

To ensure a proper operation of the instruments under all operational and climatic conditions, certain applications require provisions in addition to, or in deviation from, those specified in (4.), e.g. the use of special materials, sealing and purging (6.), heating and insulating (7.) or a combination thereof.

The application of sealing and purging shall be kept to a minimum.

5.2 STEAM SERVICE

Steam entering the impulse line(s) will condense before reaching the instrument. To establish a firm reference point for the condensate level, the impulse line(s) shall slope downwards from the instrument process connection to the instrument. Seal pot(s) with venting facilities should be provided to establish the condensate reference point(s).

For differential-pressure flow instruments these condensate reference points shall be at the same elevation.

In locations where freezing can occur, the water-filled parts of the impulse lines and the instrument shall be winterized and insulated, see (7).

5.3 FLUIDS WITH HIGH POUR POINTS

Liquids which solidify at ambient temperature shall be prevented from entering the instruments and their impulse lines in order to prevent malfunctioning and/or damage.

Special attention shall also be given to those gas services where hydrates may form at low temperatures.

In such cases, a liquid seal (6.1), a diaphragm seal (6.3) or heating (7.2) should be applied where necessary. Those parts of impulse lines which are filled with the process fluid shall be heated.

5.4 FLUIDS CONTAINING SUSPENDED SOLIDS

When process fluids contain suspended solids, the danger exists that these solids will settle in the impulse lines and ultimately cause a complete blockage.

When the concentration of the suspended solids is relatively low, blockage may be prevented by having the process connection and (short) impulse lines sloping **downwards to the process** at an angle of approximately 45°.
When the concentration of suspended solids is high, a liquid seal (6.1) or purging (6.2) should be applied.

5.5 OXYGEN SERVICES

All material for gaseous oxygen applications shall be kept separate from other materials and carefully degreased and inspected as specified in DEP 31.10.11.31-Gen.

5.6 LOW-TEMPERATURE SERVICES

Process liquids in plants operating at temperatures below ambient and which are close to their vapour pressure, will evaporate on entering the impulse lines, which are normally at ambient temperature, before reaching the instruments. The vapours so formed will push the liquid back towards the process until an equilibrium is established.

This self-purging normally occurs in all cryogenic processes operating at -100 °C to -170 °C. In other processes operating below ambient temperature, e.g. Liquefied Petroleum Gases, heating shall be considered to assist self-purging. For details of the self-purging of impulse lines, see (6.4).

5.7 CORROSIVE SERVICES

For applications where stainless steel AISI 316 is not suitable with respect to general corrosion, other materials such as monel, Hastelloy, tantalum, titanium etc, can be applied for the various components of the impulse lines, selected to suit the application in the same way as the process piping, using the piping classes (DEP 31.38.01.12-Gen. and DEP 31.38.01.15-Gen.). These components may, however, be very costly and at a later stage may inadvertently be interchanged with unsuitable stainless steel components. Therefore, for these applications, alternative installations (purging or a liquid seal) or the use of alternative (in-line) instruments shall be considered.

Approval of the Principal shall be obtained for the selected option.

5.8 TOXIC SERVICES

The Principal shall specify whether the service shall be considered toxic. For such services, the manifold valves (isolate/equalize and isolate/vent) shall be provided with an interlocking system.

All vents from manifolds for toxic/noxious services shall be connected to the (low-pressure) flare, and all drains to a drain vessel or covered pit which is allocated for toxic products and for which adequate disposal should be arranged.

The required length of tubing for the vent and drain lines, shall be added on the relevant hook-up drawing.

Where flushing and neutralizing the instrument and the manifold block is necessary before the instrument is disconnected, the instrument or the pressure manifold shall be provided with filling/ flushing connector(s), e.g. a non-return valve with a compression fitting end.

A stainless steel compression-type plug, secured by a bead-type chain to the non-return valve, shall be fitted to plug-off the compression fitting end when not in use.

A flexible metal hose provided with a compression fitting should be used to flush the instrument body and manifold.

NOTE : The maximum allowable concentration of toxic or noxious components in fluids which may be vented to the atmosphere shall be approved by the Principal.

5.9 HYDROGEN FLUORIDE SERVICES

Stainless steel type AISI 316 may, under certain conditions, be subject to pitting and/or stress cracking when applied on process fluids containing hydrogen fluoride (HF).

Impulse tubing ($^3/_8$") in HF service shall be constructed from ASTM B165 UNS NO4400 (monel) with monel compression fittings. Alternatively, welded ½" pipes (either monel or carbon steel) can be applied. Valves shall be made of monel.

NOTES:
1. Cold deformation shall be minimized by the application of the largest possible bending radius, limiting the extreme fibre deformation to 5% maximum. In practice, this amounts to a minimum bending radius of 10 to 15 times the diameter for small bore piping (under 1 inch).

2. Before HF is put into the system, a very careful check shall be performed as to the tightness of compression joints and screwed connections. Fluorides formed upon leakage will result in a very hard metal surface which will make re-tightening of the joint practically impossible.

3 When selecting the material of impulse lines in HF service, the Principal shall be consulted.

4) PTFE seals may be used in valves in HF service.

5.10 SOUR ENVIRONMENT

When the service is sour (as defined in NACE MR-01-75) all impulse line components shall comply with the requirements of NACE MR-01-75 and DEP 31.38.01.11-Gen.

When impulse line components and/or parts thereof cannot be obtained in accordance with NACE MR-01-75 (e.g. the rolled thread of some male compression fittings), the Principal shall be consulted.

NOTES :
1. The male and female threads shall be provided with a sealing material which will withstand a temperature of 538 °C

2. The front ferrules of compression fittings are the second or third sealing in the fitting and, since they need to have higher hardness in order to function properly, they may be exempted from the hardness limitations of NACE MR-01-75.

Valve head spindles and/or parts of them in contact with sour fluids shall be constructed from 17-4 PH stainless steel, stellite-coated stainless steel, stellite or Hastelloy-C meeting the requirements of NACE MR-01-75.

6. SEALING AND PURGING

6.1 LIQUID SEALS

When liquid seals are applied, the sealing liquid shall:

- have a higher density than the process fluid to be measured;
- not mix or react with the process fluid or otherwise interfere with the process;
- not evaporate under operating and ambient temperatures;
- not freeze at local ambient conditions.

Filling/flushing connector(s) shall be provided at the lowest point for filling the impulse line(s) and instrument with sealing liquid.

Seal pots shall be installed to provide a buffer volume.

6.2 EXTERNAL PURGING

External purging may be considered only if other methods to eliminate problems caused by condensation, vaporization or plugging are not practicable. Its use, however, should be avoided whenever possible since it could cause false differentials; the installation costs are also higher and more frequent maintenance is required.

The purge fluid shall be free from solids, be non-corrosive and in single phase at the operating temperatures and pressures. It shall not interfere with the process nor react with the fluid to be measured. Purge systems shall have a guaranteed source at a pressure which is constant and higher than the maximum process pressure and a low but constant flow rate shall be maintained in each line.

The approximate velocity at the process connection shall be 0.06 m/s for liquid purge and 0.6 m/s for gas or steam purge.

The purge injection point shall be close to the instrument and since the process fluid may enter part of the impulse line on purge supply failure, the materials shall be selected accordingly.

A restriction orifice nipple shall be installed to keep the purge flow constant, see Standard Drawing S 37.805. A constant pressure regulator shall be installed under varying supply or process pressures, and under increasing resistance to flow in the case of partial plugging of lines or connections.

Essentially, a purge assembly consists of a filter which can be flushed, check valve(s) and a vent valve with anti-tamper facilities. The check valve(s) shall be spring-loaded and have a soft seat to ensure a proper shut-off.

NOTE : Integral purge blocks are specified in the MESC, which contain all the facilities referred to above.

For purge pipes on vessels, see Standard Drawings S 38.047 and S 38.048. The purge pipes and isolating valves, required for external purging, are the responsibility of Mechanical Engineering.

6.3 DIAPHRAGM SEALS

For diaphragm seals, refer to DEP 32.31.00.32-Gen.

6.4 SELF-PURGING

Where self-purging is applied, process connections should be located on top or at the side of the equipment. The impulse line(s) shall drop vertically downwards from the instrument and then continue, sloping downwards at a ratio between 1:10 and 1:20 to the mechanical isolating valve(s) at the process connection. To prevent measurement errors due to liquid static head if the self-purging is not operating properly, the vertical drop from the instrument shall be as short as possible.

The first part (approximately 1 m) of the impulse line(s) from the process connection shall

be insulated to reduce heat influx to the process fluid, while the following part shall have an exposed length to enable evaporation of the process fluid by heat influx from the surrounding atmosphere.

For typical details of self-purging impulse lines, refer to Standard Form DEPs 32.37.02.81-Gen. and 32.37.02.82-Gen.

In all cases, it is necessary that all process fluids evaporate at the operating pressure and at the lowest ambient temperature. Where the liquid contains heavy components which will not evaporate at minimum ambient temperature, heating of the impulse line(s) shall be applied to assist evaporation.

Heating of impulse lines shall be provided where self-purging is not expected to operate satisfactorily under all process conditions, e.g. during start-up and shut-down.

7. HEATING AND INSULATION

7.1 GENERAL

Where heating of impulse lines is necessary for process fluid heating or winterizing, use should be made of process heat by installing the first part of the impulse line up to the seal pot inside the insulation of the process piping or equipment. Where this is not possible or when sealing liquid is not applied, the impulse lines and the wetted parts of the instrument shall be heated by an external source.

In such cases a pre-assembled instrument housing around the instrument body, manifold and heating facilities shall be provided.

For the selected type of heating medium (steam heating, electrical tracing or other means) the Principal's approval shall be obtained in writing.

7.2 STEAM HEATING

Steam heating systems shall comply with DEP 31.38.30.11-Gen.

The steam supply and condensate return piping shall run close to the take-off and return points. The steam supply piping to, and condensate return piping from, the heating block (including steam trap) are the responsibility of Mechanical Engineering.

Special tubing (see 4.1) should be used to heat the instrument impulse lines. The manifold and the instrument body shall be heated by means of a tracer block.

The arrangement shall be such that the instrument can be removed without disconnecting the tracer tubing and/or tracer block.

Special tubing (see 4.1) should be used for winterizing (steam tracing) the impulse lines, with non-metallic spacers fitted between them at least every 400 mm to prevent overheating.

When steam heating is applied for reasons of high fluid pour point, the stainless steel heater tubing and the impulse line shall be clamped together.

In all cases the clamping material shall be stainless steel.

The total number of joints in the tracer tubing shall be kept to a minimum.

NOTES :
1. Steam heating of all 'in-line' equipment (e.g. control valves, turbine meters, positive displacement meters, etc.) which is installed in process piping is the responsibility of Mechanical Engineering.
2. Hollow bolts shall not be applied to heat the instrument.

Each instrument shall have its own supply and condensate return with isolating valves, labelled with the tag number of the instrument.

Steam supply lines shall not be divided into systems which run parallel.

The steam flow in the tracer tubing shall be downwards and pockets in the tubing shall be avoided because build-up of condensate will prevent a continuous steam flow.

Each tracer line shall terminate in a condensate return line via a steam trap.

7.3 ELECTRICAL TRACING

The heating equipment shall satisfy the requirements for electrical safety in accordance with the area classification.

NOTE : Certain elements are certified only when installed in the manifold block. In such cases, power to the heating elements shall be switched on only when the elements are inserted in the manifold block.

The arrangement of the electric tracing shall be such that transmitters can be removed without disconnecting the electrical heating block.

All electrical trace heating components (except the electrical heating block and/or electrical heater attached to the manifold) are the responsibility of Electrical Engineering.

Electrical tracing shall not be applied for processes where the maximum working

temperature exceeds the guaranteed temperature limitation of the selected heating tape.

7.4 INSULATION

Those parts of impulse lines which are filled with high pour-point fluids shall be surrounded by the insulation of the process piping or equipment to keep them at the required temperature.

The traced impulse lines and instrument parts, and all steam supply lines, shall be insulated. All couplings in the tracer tubing and the impulse lines shall be accessible without removing the complete insulation.

The steam return lines may also require insulation and even winterizing to prevent freezing of the condensate.

For impulse lines, seal pots, steam supply lines, etc., the insulation should normally consist of mineral wool wrapped around and covered with a weather-proof material. The chloride content in the mineral wool insulation shall not exceed 10 mg/kg.

Other materials require the approval of the Principal.

For insulating the instrument bodies, manifold blocks and tracer blocks, prefabricated enclosures shall be applied fitting closely around those parts which are to be heated.

The body enclosures shall be constructed such that parts which require removal for disconnecting the instrument are fixed to the mounting plate.

NOTES :
1) The electronic parts of instruments should not be installed within an enclosure in order to prevent the area classification around that part being downgraded.

2) Winterizing (7.2), insulation and body enclosures shall not be provided for impulse lines in freezing climates when they are installed in temperature-controlled buildings, such as demineralized water plants, etc.

7.5 PROTECTIVE SHADES

Subject to environmental conditions, shades should be applied to protect the instruments.

Electronic instruments installed in tropical or desert climates shall be provided with a protective shade.

The shade shall be fixed to the mounting plate in such a way that quick installation and removal is guaranteed.

8. INSTALLATION DRAWINGS

For all plant-mounted instruments measuring flow, level, pressure or temperature, a set of drawings shall be available showing in detail:

- the position of the instrument with respect to the process connection(s);
- the method of supporting the instrument;
- the arrangement of the impulse lines with any special provisions, such as for purging, sealing, steam tracing, requirements for thermal expansion, vibration or other pipe movements;
- a list of the materials required;

Copies of these drawings, including an application guide which shall be used for all projects are available as Standard Forms in two separate versions as indicated below:

1) A **METRIC VERSION** applying 10 mm OD stainless steel tubing, see DEP 32.37.02.81-Gen., which should be used for all new projects, and
2) An **IMPERIAL VERSION** applying 3/8 inch OD stainless steel tubing, see DEP 32.37.02.82-Gen., for the maintenance of existing installations or where locations have standardized on imperial sized impulse lines.

One drawing for more than one instrument is allowed when the hook-ups are truly identical in the details given above.

One drawing should show pressure gauges connected to horizontal and vertical pipes and/or vessels.

The impulse lines are shown on the drawings in thick lines and all other piping and equipment in thin lines.

The isolating valves and cover flanges are shown in dotted lines.

If 'hook-up' drawings other than those given in the Standard Form have to be prepared, they shall be of A-4 size, using blank Standard Form Sheets DEP 05.00.54.80-Gen., but with the DEP number removed.

The numbers of items applied shall be in accordance with DEP 32.37.02.80-Gen.

The drawings shall be assembled in one set for each processing unit, complete with cover sheet, index sheets, list of materials, etc.

On the applicable drawings, the density of the sealing liquid is assumed to be higher, and that of the purging liquid to be lower, than the density of the process liquid.

"Engineering notes" have been included on some of the drawings for assistance in the proper use thereof.

For instruments with two almost identical impulse lines, e.g. flow transmitters, only one line need be itemized, but differing items in the other line shall be indicated.

For instruments requiring heating and or weather protecting facilities, a code shall be indicated as follows:

H = heating
W = winterizing
E = electric tracing (thermostatically controlled)
B = body enclosure
P = protective shade
(See DEPs 32.37.02.81-Gen. and 32.37.02.82-Gen.)

The quantity column on each drawing shall indicate the quantity of material required for the installation shown on that sheet. The total quantities required for all instruments covered shall be entered on Standard Forms DEP 32.37.02.80-Gen. which form the basis for requisitioning materials, making a reasonable allowance for spare materials.

NOTE : The contractor may wish to apply a computerized system for the handling of installation materials which should provide the following information:

- itemized material requirements per sheet
- total requirements per item
- information of material ordering.

If the contractor intends to use such a computerized system, approval shall be obtained from the Principal on the format and contents of the computer output sheets.

For the "Summary of Instrument Installation Materials", see Standard Form DEP 32.37.02.80-Gen. Material items not covered in these forms shall be entered on the list and an item number shall be allocated accordingly.

9. REFERENCES

Amended per Circular 33/97

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.

Amended per Circular 46/99

SHELL STANDARDS

Index to DEPs and Standard Specifications	DEP 00.00.05.05-Gen.
* General Purpose Sheet	DEP 05.00.54.80-Gen.
Gaseous-oxygen Systems	DEP 31.10.11.31-Gen.
Piping General Requirements	DEP 31.38.01.11-Gen.
Piping Classes	DEP 31.38.01.12-Gen.
Piping Classes - Exploration and Production	DEP 31.38.01.15-Gen.
Protective steam heating of piping systems	DEP 31.38.30.11-Gen.
Instruments for measurement and control	DEP 32.31.00.32-Gen.
* Summary of Instrument Installation Materials	DEP 32.37.02.80-Gen.
* Instrument Impulse Line Assemblies "METRIC VERSION"	DEP 32.37.02.81-Gen.
* Instrument Impulse Line Assemblies "IMPERIAL VERSION"	DEP 32.37.02.82-Gen.

NOTE: The DEPs marked * are Standard Forms, and can be found in binder DEP 00.30.10.05-Gen.

MATERIALS AND EQUIPMENT STANDARDS AND CODE (MESC):

Specification for gauge blocks, isolate/vent	MESC 60.98.55/201

STANDARD DRAWINGS

Purge orifice nipple	S 37.805
Parallel threaded connections	S 37.808
Details of parallel threaded pressure transducers	S 37.809
Mounting plate (L-shape)	S 37.813
Mounting plate (rectangular)	S 37.814
Purge pipe for carbon steel and low-alloy steel apparatus	S 38.047
Purge pipe for stainless steel and non-ferrous apparatus	S 38.048

AMERICAN STANDARDS

Pipe flanges and flanged fittings, NPS $^1/_2$ through NPS 24 — ASME/ANSI B16.5

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

Sulfide stress cracking resistant metallic materialfor oil field equipment — NACE MR-01-75

Issued by
National Association of Corrosion Engineers,
1440 South Creek,
Houston,
Texas 77084, USA

Specification for Seamless and Welded Austenitic Stainless Steel Piping for General Refinery Service — ASTM A269

Issued by
American Society for Testing and Materials,
1916 Race St.,
Philadelphia,
19103, Pa., USA

INTERNATIONAL STANDARDS

Plain end steel tubes, welded and seamless — ISO 4200
- General tables of dimensions and masses per unit lenght

Issued by
International Organization for Standardization,
1, Rue de Varembé,
P.O. Box 56,
CH-1211 Geneva 20
Switzerland

APPENDIX 1 PRESSURE AND TEMPERATURE LIMITATIONS

Temperature, °C	Maximum working pressure, bar (ga)		
	SS tubing 10 mm OD wall thickness 1.5 mm	Components with grafoil packing	Components with PTFE packing and PTFE tape
- 200	413	413	-
- 150	413	413	-
- 100	413	413	400
- 50	413	413	400
0	413	413	400
+ 50	413	399	400
+100	413	351	350
+150	411	320	300
+200	398	297	200
+250	372	276	-
+300	357	260	-
+350	342	245	-
+400	332	235	-
+450	325	200	-
+500	319	-	-
+538	316	-	-

NOTES : 1. The maximum working pressures for 10 mm OD x 1.5 mm WT stainless steel tubing have been calculated using the formula:

$$P = \frac{2S_m \cdot t_{min}}{Do_{max} - 0.8t_{min}}$$

in which:

t_{min} = the minimum standard wall thickness

Do_{max} = the standard maximum outside diameter

S_m = the maximum allowable stress in the material caused by internal pressure at the design temperature

The tolerances for metric sized tubing are in accordance with ISO 4200.

2. The maximum working pressure for $^3/_8$ inch OD x 0.065 inch WT stainless steel tubing are 1.09 times the pressures given in the table above. The tolerances for imperial sized tubing are in accordance with ASTM A269.