

DEP SPECIFICATION

INSTALLATION OF ON-LINE INSTRUMENTS

DEP 32.37.10.11-Gen.

February 2011

(DEP Circular 57/12 has been incorporated)

ECCN EAR99

DESIGN AND ENGINEERING PRACTICE



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1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for the installation of on-line instruments.

This DEP is a revision of the DEP of the same number, dated October 2001; see (1.5) regarding the changes.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by Shell GSI, the distribution of this DEP is confined to Shell companies and, where necessary, to Contractors and Manufacturers/Suppliers nominated by them. Any authorised access to DEPs does not for that reason constitute an authorization to any documents, data or information to which the DEPs may refer.

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 should 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

Direct mounting A mounting concept, whereby an on-line instrument (with or without manifold) is mounted directly on and supported by the process connection(s).

NOTE: This mounting concept is sometimes referred to as 'close coupled'. This term is however also used in the literal sense for instruments mounted on a separate stand in the direct vicinity of the process connection(s). To avoid confusion, the term 'close coupled' is no longer used in this DEP.

Electrical Engineering Term used in this DEP to identify activities or devices/components 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.

Impulse line(s) Components used to connect an on-line instrument to its process connection. It includes but is not limited to tubing, fittings and manifold blocks plus components for filling, flushing, sealing, purging, heating, insulation, venting, draining, mounting and supporting.

Mechanical Engineering Term used in various parts of this DEP to identify activities or devices/components that 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 that may otherwise be overlooked.

On-line instrument Instruments connected to process and utility lines or equipment via small (maximum DN 50) block valves. They are subjected to the pressures of the piping systems or equipment on which they are installed. The block valves are referred to as primary isolation valves in the context of this DEP.

Instruments with diaphragm seals are also considered to be on-line instruments, if they are connected to process and utility lines or equipment via primary isolation valves of any size.

Remote mounting A modular mounting concept, whereby an on-line instrument (with or without manifold) is installed on a dedicated instrument mounting support and connected with the process connection via tubing, capillary or pipe.

Very toxic See definition in DEP 00.00.01.30-Gen.

1.3.3 Abbreviations

LRV Lower Range Value; the lowest quantity that a device is adjusted to measure

MTBF Mean Time Between Failure

MVC Measurement Validation and Comparison

TCoO Total Cost of Ownership

URV Upper Range Value; the highest quantity that a device is adjusted to measure

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 (8).

1.5 SUMMARY OF CHANGES

This DEP is a revision of the DEP of the same number, dated October 2001.

The following are the main, non-editorial changes.

Old section	New section	Change
	All	Background information, explanation, and guidance have been removed.
	2.2.2.1	Addition of details supporting close-mount concept
	4.1	Provided additional details supporting the use of Incoloy 825 for tube installations
	4.2.2.5	Additional details for Line Supported Transmitters
	4.5	Further details to testing conditions
	References	Added reference to MESC SPE 74/052

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

**Amended per
Circular 57/12**

Dual units have been incorporated throughout this DEP.

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

2.1 INTRODUCTION

This DEP should be used in conjunction with DEP 32.31.00.32-Gen.

The best hook-up arrangement for each on-line instrument shall be determined on the basis of the specifications given in Sections (4) and (5) and the additional requirements of sections (6) and (7) on sealing, purging, heating and insulation.

The selected hook-up shall guarantee proper measurement at all normal and abnormal process operating and climatic conditions. Instrument sealing and purging shall only be used if alternative hook-ups arrangements are less attractive from a TCoO, measurement accuracy or maintenance point of view.

To obtain acceptable response times, the kinematic viscosity of liquids in impulse lines shall be kept below $200 \text{ mm}^2/\text{s}$ (200 cSt) under all normal and abnormal conditions for remote mounted instruments. Instruments installed with remote seals and capillary type filled lines are not subject to this requirement due to the response of the instrument and sealed fluid being acceptable (as designed and recommended by the instrument manufacturer).

In locations where freezing may occur, the water-filled parts of sensing lines and the instrument shall be winterised (i.e. heated and insulated), see (7).

For access requirements and guidance on selecting the location of instruments and instrument process connections, refer to DEP 32.31.00.32-Gen.

Impulse lines for sample take-off and transport for on-line process stream analysis are covered by DEP 32.31.50.10-Gen.

Installation drawings for instrument impulse lines shall be prepared in accordance with the requirements of DEP 32.31.00.10-Gen.

2.2 DESIGN CONCEPTS

This DEP covers the requirements for two distinct design concepts:

- Remote mounting concept, as example given in Figure 1;
- Direct mounting concept, as example given in Figure 2.

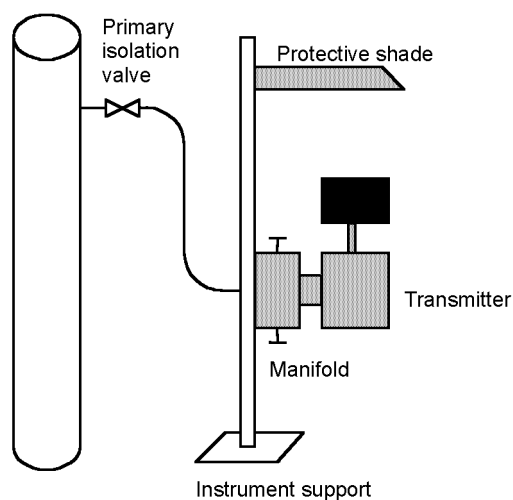


Figure 1 Example of remote mounting concept.

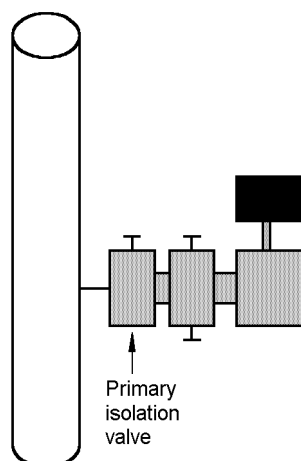


Figure 2 Example of direct mounting concept

2.2.1 Remote mounting concept

The process is connected to the manifold and instrument through tubing with compression fittings. Maintenance requirements have dominated the design of the remote mounting concept. The concept is based on a need for permanent access and includes facilities for in situ testing and calibration.

Typical hook-up arrangements with MESC-coded component listings are available for liquid, gas and steam applications as given in standard drawings S 37.001 (metric version) and S 37.002 (US Customary version).

Metric tubing (10 mm OD) and compression fittings should be used for new projects. The application of US Customary sized tubing (3/8 inch OD) and related compression fittings should be restricted to locations that have standardized on US Customary sizes, and may only be applied if approved by the Principal.

The reliable and proven use of compression fittings requires that:

- all compression fittings in a plant, including those supplied with equipment packages, shall be of the same size, make and type. Mixing of fittings of different size (e.g. metric with US Customary) or different make/type will result in unreliable joints and might consequently result in loss of containment; the make is subject to Principal's approval.
- the fittings and tubing shall be installed by skilled personnel, strictly in accordance with Manufacturer's instructions;
- the impulse lines shall be pressure tested after installation, see (4.5).

2.2.2 Direct mounting concept

2.2.2.1 General

In the direct mounting concept, the on-line instrument and its manifold are mounted directly on and supported by the process connection(s).

2.2.2.2 Close mount concept

Close mount concept utilizes an instrument stand that is attached to the process pipe with short run of tubing to the transmitter [typically less than 1 m (3ft)]. The close mount installation is used when it is acceptable to install an instrument stand on a pipe and the access meets the "limited accessibility" criteria in DEP 32.31.00.32-Gen.

If the pipe is insulated, then the design shall incorporate an "over the insulation design". It is not acceptable to break the barrier of the insulation due to corrosion under insulation (CUI). Additionally, some pipe is considered "critical" in terms of corrosion; instrument stands shall not be placed on uninsulated critical pipe.

This installation has the advantages of the direct mounting installation (e.g. low cost, short impulse lines, reduced plugging, ability to rod out, minimal issues with filling the seal leg, reduced cost of tracing) without the issues of the direct mounting design.

2.2.3 Comparison of design concepts

2.2.3.1 General

It is essential to make the selection between the remote mounting and the direct mounting concept in an early project stage. This Section lists aspects to be considered.

2.2.3.2 Accessibility

For maintenance purposes, permanent and easy access used to be the dominant factor in selecting the physical location of remote mounted instruments. Long impulse lines and additional ladders/platforms were the result.

The location of a direct mounted instrument is fully determined by the physical location of the process connection, which typically provides limited freedom for positioning.

Major improvements in MTBF, MVC techniques and remote diagnostics via 'intelligent' communication have drastically reduced the need for on-the-spot maintenance of modern field instruments.

Minimum accessibility requirements are specified in DEP 32.31.00.32-Gen.

2.2.3.3 Performance and maintenance aspects

The compactness of the direct mounting concept brings the sensor closer to the process which improves the measurement accuracy and makes the measurement less susceptible to the proper functioning of heating and insulation. Shorter runs and fewer fittings reduce vulnerability to damage and leaks.

2.2.3.4 Responsibilities, risks and construction timing

The installation of a remote mounted transmitter (material delivery/erection/wiring/loop testing) is hardly affected by the progress of piping installation activities and therefore not time critical. Remote mounted transmitters (including the impulse lines) shall be preserved where the final connections cannot be completed due to outstanding completion.

Most direct mounting concepts include the primary isolation valve (e.g. by using monoflanges), which requires additional co-ordination between the Mechanical and Instrument Engineering disciplines, as the concept should satisfy the requirements of both disciplines. The Manufacturer should be selected in an early project phase, as proprietary design details affect plant design. Furthermore, the primary isolation valve should be installed before pressure testing of equipment and process piping, which might not be the appropriate time for transmitter installation and associated instrumentation activities.

2.2.3.5 Variety control

If the direct mounting concept is selected, it will not be suitable for all applications, so both concepts will be mixed on a specific project. This will increase the variety of components and Engineering effort.

2.2.3.6 Design aspects

For the direct mounting concept, the following aspects need specific attention:

- To prevent too high stresses on the process nozzle, the length and weight of the instrument with its accessories shall be reviewed, especially in vibrating service and on small bore process piping.
- Direct mounting is less suitable for applications that require rodding out of process connections.
- The compactness of most direct mounting designs causes the instrument housing to operate close to the process operating temperature. The upper and lower temperature limits of sensor fill fluids/electronics of instruments restrict the use of the direct mounting concept in low and high temperature applications.

- When the direct mounting of a differential pressure type flow meter is considered, the transmitter/manifold shall be supported by only one of the tappings and connected by tubing to the second tapping. If the transmitter is supported by two tappings pointing in the same direction, as shown in Figure 3, a slight misalignment of the tapping points causes leakage and undue stress at the mounting bolts. Furthermore, the thickness of an orifice plate depends on the plate type and its nominal pipe size.

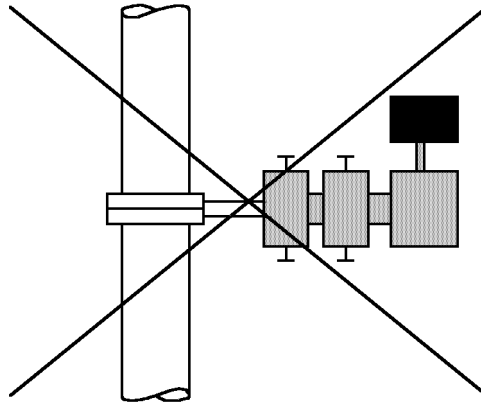


Figure 3 **Incorrect direct mounting of a DP flow transmitter/manifold by supporting it from both tappings**

3. INSTRUMENT PROCESS CONNECTIONS FOR ON-LINE INSTRUMENTS

3.1 GENERAL

Process connections for on-line instruments shall have dedicated primary isolation valves to allow disconnection from the process (applicable for direct mounted pressure gauges as well). Only if a loop requires multiple instruments to cover the full operating range may the primary isolation valve(s) be shared, providing that secondary isolation is available for each instrument.

NOTE: In certain applications, a straight through type primary isolation valve, e.g. gate, ball or plug valve, may be required to allow rodding out of plugged connections.

The flange facing finishing of direct mounting components (e.g. gauge blocks) and lap joint tube adapters shall be in accordance with ASME B16.5.

The number of connections shall be minimised. Where required, compression fittings and/or flanged connections are preferred. For certain applications, the Principal may specify threaded connections. Following factors shall be considered for threaded connection:

- Piping class;
- Type of service;
- The process pressure.

Parallel threaded connections with soft annealed metal sealing rings, as shown in Standard Drawings S 37.808 and S 37.809, have preference over tapered sealing connections for their leak tightness.

NOTE: Tapered threaded connections such as NPT require a thread sealant such as PTFE. See Appendix 1 for temperature limitations.

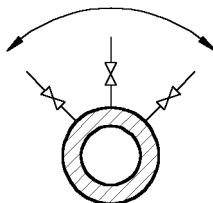


Figure 4 Top tapping

Instrument process connections on horizontal process lines shall be located at the top (vertically up or pointing upwards at an angle of up to 45 degrees from the vertical axis) to limit the blocking risk by solids, dirt or pipe scale, as shown in Figure 4.

For liquid measurements on horizontal process lines, however, this arrangement can cause gas to collect in the impulse lines. In such cases, side tapping are preferred. If this is not feasible, the effect on the measurement accuracy should be limited by installing seal pots to allow regular venting and/or by minimising the difference in elevation between the top of the impulse line and the instrument process connection, as shown in Figure 5 and Figure 6.

If a liquid contains vapours or dissolved gas, the process connection should be installed in a vertical line. If a process connection can only be made available from a horizontal line, the tapping should be either at the side or pointing downwards at an angle of up to 45 degrees from the horizontal axis. The impulse lines shall slope downwards to the instrument so that gas is automatically vented back into the process, as shown in Figure 7. Downward pointing tapping in horizontal lines are vulnerable to fouling and may only be used if approved by the Principal.