

PETRONAS TECHNICAL STANDARDS

DESIGN AND ENGINEERING PRACTICE

MANUALS

INSTALLATION OF ON-LINE INSTRUMENTS

PTS 32.37.10.11

NOVEMBER 2009



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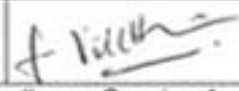
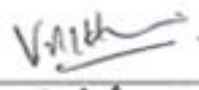
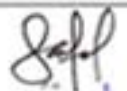
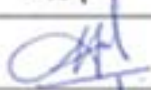
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This revision of **PTS 32.37.10.11 – Installation of On-Line Instruments** has been updated incorporating PETRONAS Lessons Learnt, Best Practice and new information issued by relevant industry code and standards. All updates in the document are highlighted in *italic* font.

The previous version of this PTS (**December 2007**) will be removed from PTS binder/ e-repository from herein onwards.

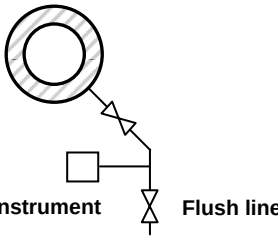
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Revision History

Date	Version	Description of Updates	Author

SUMMARY OF CHANGES

Section	Description of Changes
1.3.2 Abbreviations	1.1.1 Following abbreviations were added: MTBF Mean Time Between Failure MVC Measurement Validation and Comparison TCoO Total Cost of Ownership
2.2.1 Remote Mounting Concepts	MESC reference were removed as follows (bold and strikethrough) The remote mounting concept has proven to be very valuable and covers all frequently applied hook-up arrangements. 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 (imperial version).
2.2.3.7 Design aspects	Rephrase as follows (bold): 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 need to be reviewed, especially in vibrating service and on small bore process piping and very high temperature service. Co-ordination with Mechanical Engineering is required. - Direct mounting is less suitable for applications that require rodding out of process connections. However, if auto-rodder is used, direct mounting is preferred.
3.1 General	Rephrase as follows (bold): If a liquid contains vapours, dissolved gas or low temperature (below ambient temperatures) liquids e.g. LNG, LPG, etc, 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 except for low temperature liquids where the process connection shall remain horizontal or pointing upwards. 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 tapplings in horizontal lines are vulnerable to fouling and may only be used if approved by the Principal. If downward-pointing tapping is used, provide proper flushing facility as shown in Figure 7a; further consideration on this configuration in 4.3. Following figure were added  Instrument Flush line Figure 7a (new) Downward-pointing tapping with flushing facility
4.1 Specification	<u>Para 3 (adding in bold)</u>

Section	Description of Changes
of Components	For applications where AISI 316 stainless steel is not suitable, other materials such as Duplex, Super Duplex, Incoloy, Monel, Hastelloy, Tantalum or Titanium should be applied. <u>Para 4 (adding new list and rephrase notes - bold)</u> UNS S32750 Alloy 2507 e.g. Super Duplex 2507 NOTES: 1. However for super duplex tubing, only super duplex fitting shall be used, the three groups of tubing materials, listed above, may be used in conjunction with AISI 316 type stainless steel compression fittings. 2. The hardness of the high nickel alloy tubing shall be within the range of 77 HRB to 83 HRB, hardness of super duplex tubing shall be within 30 HRC. <u>Para 5 (rephrase - bold)</u> Stainless steel impulse line components may be selected on the basis of the MESG numbers given on standard drawings S 37.001 (Instrument impulse lines, metric version) or S 37.002 (Instrument impulse lines, imperial version). Gauge blocks shall be provided with a 1/2 inch female threaded gauge adapter (not applicable when gauges integral with tube adapter are used). The type of thread for the pressure gauge (tapered 1/2 inch NPT or parallel G 1/2 inch) shall be specified by the Principal. To reference PTS 32.31.09.31 for calculation on TCoO.
4.2.1 General	Additional notes added: Note: The protective shade should be installed for exposed instrumentation in tropical and desert environment
4.2.2.3 Instrument location and routing of impulse line tubing	1.1.1.1 Para 2 rephrase as follows (bold): For straight lengths up to a maximum of 1 m the tubing is self-supporting, for longer lengths the tubing shall be supported up to maximum of 1 m intervals with proper tube supports/clamps.

PREFACE

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The objective is to set the recommended standard for good technical practice to be applied by PETRONAS' OPUs in oil and gas production facilities, refineries, gas processing plants, chemical plants, marketing facilities or any other such facility, and thereby to achieve maximum technical and economic benefit from standardisation.

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1. INTRODUCTION

1.1 SCOPE

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

This PTS is a revision of the PTS of the same number, dated December 2007.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by PETRONAS, the distribution of this document is confined to companies forming part of or managed by PETRONAS, and to Contractors nominated by them.

This PTS 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 PTS, 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 PTS 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 PTS as closely as possible.

1.3 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** indicate a requirement.

The word **should** indicate a recommendation.

1.3.1 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 PTS.

Electrical Engineering

Term used in this PTS 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 PTS 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.

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 PTS.

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.

For more detailed definition, refer to: PTS 32.31.00.32: Instruments for Measurement and Control.

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 PTS 00.00.01.30

1.3.2 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
TCO	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 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 ([8](#)).

2. GENERAL

2.1 INTRODUCTION

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 $200 \text{ mm}^2/\text{s}$ under all normal and abnormal conditions.

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 PTS 32.31.00.32.

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

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

2.2 DESIGN CONCEPTS

This PTS 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](#).

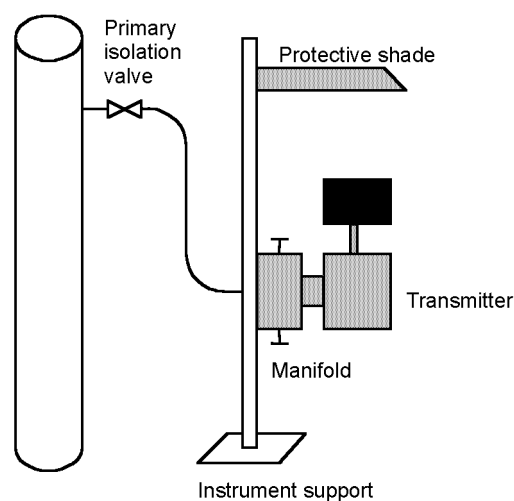


Figure 1 Example of remote mounting concept.

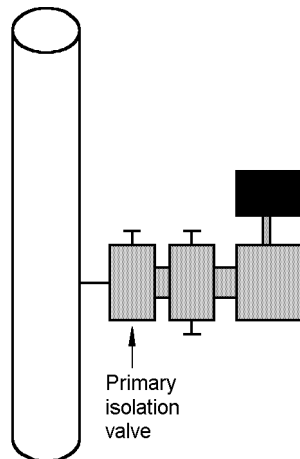


Figure 2 Example of direct mounting concept

2.2.1 Remote mounting concept

In the early 1980s, a modular mounting concept was developed for transmitters mounted remotely from the process connection(s): a mounting plate, attached to a dedicated instrument mounting support, accommodates the transmitter, manifold, heating element with terminal box, insulation covers, nameplate and protective shade, as required. Tubing with compression fittings interconnects manifold and process connection(s).

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.

The remote mounting concept has proven to be very valuable and covers all frequently applied hook-up arrangements. Typical hook-up arrangements with component listings are available for liquid, gas and steam applications as given in standard drawings S 37.001 (metric version) and S 37.002 (imperial version).

Metric tubing (12 mm OD) and compression fittings should be used for new projects. The application of imperial sized tubing (1/2 inch OD) and related compression fittings should be restricted to locations which have standardized on imperial sizes and requires approval 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, type and suitable material composition as the tubing. Mixing of fittings of different size (e.g. metric with imperial) 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; e.g. avoidance of over-tightening, use of correctly sized tubing, etc.
- the impulse lines shall be pressure-tested after installation, see [\(4.5\)](#).

2.2.2 Direct mounting concept

Reduced access needs for modern instrumentation, the increased TCoO awareness and product developments have paved the way for alternative mounting concepts, such as direct mounting.

In the direct mounting concept, the on-line instrument and its manifold are mounted directly on and supported by the process connection(s). Some designs combine the primary isolation valve and instrument manifold in one component, for instance in a monoflange-type device.

This concept is characterised by a small number of components, forming a compact design. This concept is not standardized (no standard forms), but leaves the market forces to find economically attractive and technically sound solutions within the constraints specified in this PTS. Consequently, the solutions offered by the various Manufacturers will be different and the role of the Manufacturer will be that of a solution-provider rather than just a material Supplier.

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

The remote mounting concept provides some freedom regarding instrument location and the resulting 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 PTS 32.31.00.32

2.2.3.3 TCoO

The cost involved with the remote mounting concept is high due to the large number of components, the need for an instrument mounting support and the labour intensive installation and testing. Furthermore, tubing and fittings are vulnerable to damage, particularly in the construction phase of a project.

These disadvantages do not apply to the direct mounting concept. Furthermore, the use of fewer components and connections can be a major cost saver.

When the direct mounting concept is chosen, extra cost may be involved to meet the minimum access requirements for specific field instruments (e.g. instruments that require regular in situ testing and/or calibration).

2.2.3.4 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.

2.2.3.5 Responsibilities, risks and construction timing

The remote mounting concept entails a clear demarcation of scope between the Mechanical and Instrument Engineering disciplines. The design is proven and the components are available as commodity items.

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.

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.

2.2.3.6 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.

2.2.3.7 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 need to be reviewed, especially in vibrating service and on small bore process piping and very high temperature service. Co-ordination with Mechanical Engineering is required.
- Direct mounting is less suitable for applications that require rodding out of process connections. However, if auto-rodder is used, direct mounting is preferred.
- 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.