INTERNATIONAL STANDARD

ISO 2186

Second edition
2007-03-01

Fluid flow in closed conduits — Connections for pressure signal transmissions between primary and secondary elements

Débit des fluides dans les conduites fermées — Liaisons pour la transmission du signal de pression entre les éléments primaires et secondaires

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Reference number
ISO 2186:2007(E)

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 2186 was prepared by Technical Committee ISO/TC 30, *Measurement of fluid flow in closed conduits*, Subcommittee SC 2, *Pressure differential devices*.

This second edition cancels and replaces the first edition (ISO 2186:1973), which has been technically revised.

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Introduction

The primary devices are flow meters described in ISO 5167 (all parts).

A secondary device in this context receives a differential pressure signal from a primary device and can display the differential pressure value and convert it into a signal of a different nature, i.e. an analogue or digital signal, to transmit the value of the differential pressure to another location.

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Fluid flow in closed conduits — Connections for pressure signal transmissions between primary and secondary elements

1 Scope

This International Standard sets out provisions for the design, lay-out and installation of a pressure signal transmission system, whereby a pressure signal from a primary fluid flow device can be transmitted by known techniques to a secondary device safely and in such a way that the value of the signal is not distorted or modified.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4006, *Measurement of fluid flow in closed conduits — Vocabulary and symbols*

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ISO 5167-1:2003, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full — Part 1: General principles and requirements*

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ISO 5167-2, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full — Part 2: Orifice plates*

ISO 5167-3, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full — Part 3: Nozzles and Venturi nozzles*

ISO 5167-4, *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full — Part 4: Venturi tubes*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4006 and ISO 5167-1 and the following apply.

3.1
secondary device
device which receives a differential pressure signal from a primary device, may display the differential pressure value and may convert it into a signal of a different nature, i.e. an analogue or digital signal, to transmit the value of the differential pressure to another location

4 General principles

4.1 Safe containment

The differential pressure signal shall be transmitted in a safe manner within a pipe or tubing to the secondary device. This requires that the fluid between the primary and secondary device be safely contained. Safe containment of the fluid requires conformity to the applicable standards and codes and requires the selection of the proper materials of construction, the fabrication methods and practices and any required gaskets and

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sealing materials. For on-line maintenance or verification, design shall cover safe means for proof of isolation, depressurization, flushing and removal/replacement of secondary instrumentation.

4.2 Piping specification

The pipe or tubing installed between the primary and secondary device should comply with applicable national standards and codes of practice.

NOTE 1 National regulations can also apply.

A process-piping specification should include the specification for the isolation valve (or block valve) closest to the primary device. The specification for the piping or tubing between this isolation valve and the secondary device, including any additional valves in this piping, may differ from the piping specification for the isolation valve. This is because the small size, and often the more limited temperatures involved on the instrument secondary piping, justifies these differences.

The break (change) in piping specification between the process and the instrument (or secondary) side is normally at the process isolation valve on its secondary connection end (see Figure 1). If the process-piping specification requires flanged connections, then the process end of the isolation valve is flanged and the mating flange on the secondary side is an instrument connection or may have another approved fitting.

NOTE 2 An approved hydrostatic test can be required for piping systems to prove the integrity of the pressure-containing parts of the piping system.

NOTE 3 Some installations require provision for “rodding out” of the process connections. This is the use of a rod or other physical device to remove materials blocking the free flow of fluid in the impulse lines. Safety precautions apply.

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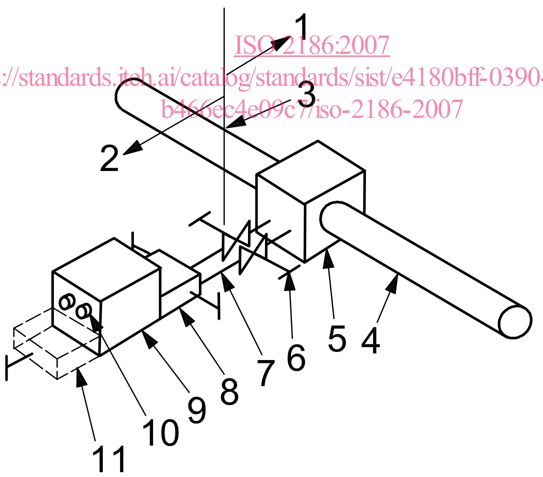

Key

1 primary side
2 secondary side
3 specification break, where the piping specifications change between secondary and primary
4 conduit running full
5 primary head creating device
6 isolation valves
7 impulse line connecting pipe
8 manifold
9 secondary device
10 bleed valves, typical
11 alternative location of equalization valve

Figure 1 — Primary and secondary at same elevation, preferred installation

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4.3 Isolation (block) valves

Isolation (block) valves are required to separate the entire measurement system from the main pipeline, when necessary, but they should not affect the pressure signal.

It is recommended that isolating valves should be located immediately following the pressure tappings of the primary element. If condensation chambers are installed, isolation valves may also be fitted immediately following the condensation chambers. However, if condensation chambers are used, it is important to check that they are emptied regularly and that they do not become a source of leaks due to corrosion.

When specifying an isolation valve, practical considerations include the following.

a) The valve shall be rated for the pipe design pressure and temperature.

b) There shall be a careful choice of both valve and packing, particularly in the case of dangerous or corrosive fluids and with gases such as oxygen.

c) Valves shall be chosen that do not affect the transmission of a pressure signal, particularly when that signal is subject to any degree of fluctuation.

Ball valves or gate valves should be used where possible, as globe-style block valves can create a pocket of gas or liquid if they are installed with the valve stem in the vertical plane.

NOTE This pocket can result in a distortion of the pressure difference, which can result in an error in the indicated measurement. Installation with the valve stem at an angle of 90° from the vertical normally solves this problem.

4.4 Valve manifolds

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Valves are often installed to permit operation, calibration and troubleshooting of the secondary device without removing it. Some typical valve manifold configurations are shown in Figure 2.

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These valves are used

a) to isolate the secondary device from the impulse lines;

b) to open a path between the high and low pressure sides of the secondary device. The secondary device zero (no flow signal) can be adjusted at operating pressure with one block valve closed and the bypass valve(s) open;

c) to drain or vent the secondary device and/or the impulse piping to the drain or to atmosphere.

Manufactured valve manifolds can reduce cost and save space. Valve manifolds integrate the required valves and connections into one assembly. Valve manifolds shall be installed in the orientation specified by the manufacturer to avoid possible errors caused by trapped pockets of gas or liquid in the body.

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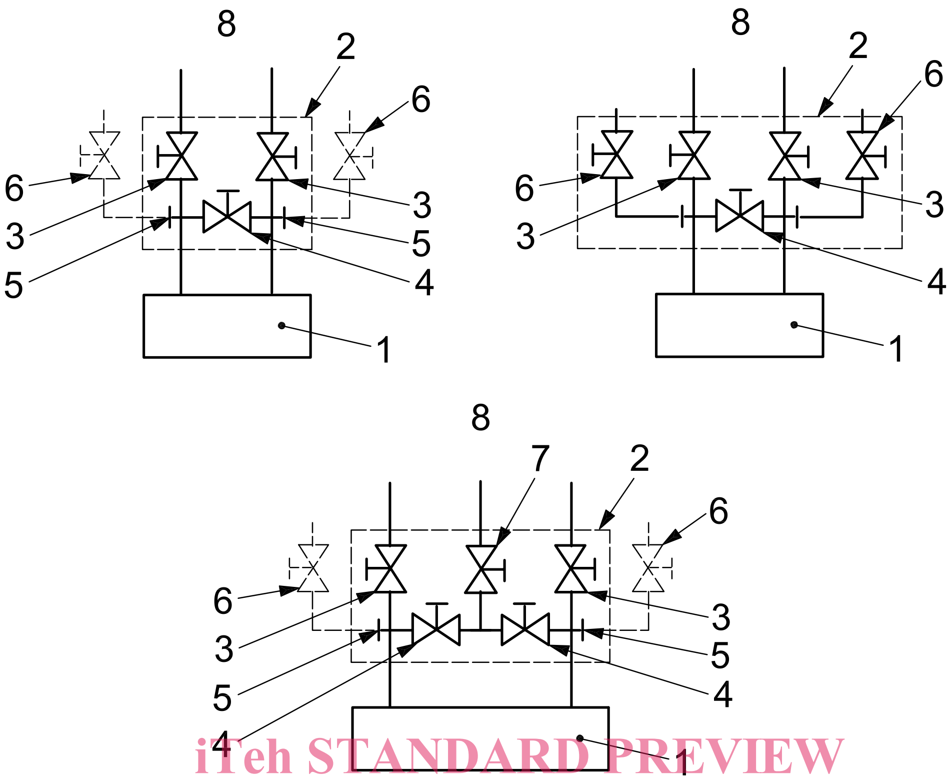

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Key

1 secondary instrument
2 manifold block
3 block valve
4 equalizer valve
5 vent, drain and calibration plug
6 vent, drain and calibration valve (optional if dashed)
7 vent, drain and calibration valve
8 process side

Figure 2 — Typical manifold configurations

4.5 Installation

The installation design should minimize the separation between the primary and secondary devices. The connecting piping is variously referred to as “impulse lines”, “gauge lines”, “instrument tubing” or “instrument piping”.

The detailed design for the installation of the flow meter secondary system should consider instrument troubleshooting and calibration. To accurately convey the pressure difference, the instrument lines shall be as short and direct as possible and the two lines should be the same length.

NOTE 1 For circumstances where the instrument lines are necessarily long, guidance on the preferred line diameter is given in Annex A. See additionally 4.7.1, 4.7.2 and 4.7.3.

Access to the impulse lines, the valves, the valve manifold and the secondary device is required to enable maintenance and calibration. Installations providing this access shall not increase measurement uncertainties by being excessively long with excessive fittings.

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Any difference in elevation between the primary device pressure taps and the secondary device results in a pressure difference between the two ends of the impulse lines due to the hydrostatic pressure of the fluid column in the impulse lines.

NOTE 2 This effect is usually greater for liquids than for gases.

The impulse lines shall be installed in such a way that the hydrostatic pressure in the two impulse lines is identical. If the fluids in the two lines are not identical in density, a difference in pressure is generated. Density differences arise when there is a temperature difference between the fluids in the two impulse lines. It is recommended that, if possible, the two impulse lines be fastened and insulated together, when it is required to avoid significant temperature differences between them.

NOTE 3 Non-identical fluids in the two impulse lines can also give rise to density differences.

The impulse lines shall be installed so that the slope is in one direction only (upward or downward depending on the fluid; see Clauses 5 and 6. If a change to the slope direction is unavoidable, then only one such change shall be made. In this case, a liquid trap shall be installed at the lowest point in gas service and a gas trap shall be installed at the highest point in liquid service.

Where possible, the impulse lines should be "bled" or "vented" after installation to clear the impulse lines of fluids left during construction or after hydrostatic testing or cleaning. Bleed valves may be included in the valve manifolds or in the secondary device body, or installed as needed.

NOTE 4 Periodic bleeding can be required if the characteristics of the fluids in the impulse lines change over time with fluid ageing and with diffusion or leakage into or out of the impulse lines.

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It is good practice to design the installation to allow for natural draining of liquids or venting of gases.

Errors caused by tap-elevation differences and pressure and temperature effects on the secondary device are reduced if the zero flow indication and transmission secondary instrument signal output is adjusted while the system is at the operating pressure and temperature and there is no flow through the system.

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NOTE 5 Depending on the installation and materials used, non-flowing fluid in the piping can exchange sufficient heat to the environment to change the temperature up to tens of degrees Celsius towards ambient over a distance of hundreds of millimetres and hundreds of degrees Celsius over a distance of a metre.

4.6 Pressure taps

The pressure tap is part of the primary device. The requirements for the pressure tap (hole size, orientation, etc.) found in ISO 5167-1:2003, 5.4.3, which also makes cross reference to ISO 5167-2 (orifice plates), ISO 5167-3 (nozzles) and ISO 5167-4 (Venturi tubes), shall be used.

NOTE In very dirty services, diaphragm seals mounted flush with the internal surface of the pipe have sometimes been used. To ensure measurement sensitivity, diaphragms are typically a nominal 80 mm or 100 mm in diameter. These diaphragm seals are not within the scope of ISO 5167 (all parts).

4.7 Impulse line size

4.7.1 General

The required diameter of the impulse line depends on the service conditions. Lines having an internal diameter less than 6 mm do not easily allow gas bubbles to flow up and out of a liquid system, nor allow liquid drops to flow down. In smaller impulse-line sizes and with liquids, capillary effects can become significant. If condensation is likely to occur, or if gas bubbles are likely to be liberated from a liquid, the bore diameter shall be not less than 6 mm and should preferably be at least 10 mm. The internal diameter should not exceed 25 mm.

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