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Hydraulic fluid power — Measurement techniques —

Part 2:
Measurement of average steady-state pressure in a closed conduit

Transmissions hydrauliques — Techniques de mesurage —

Partie 2: Mesurage de la pression moyenne dans un conduit fermé en régime permanent

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 131, *Fluid power systems*, Subcommittee SC 8, *Product testing.*

This second edition cancels and replaces the first edition (ISO 9110-2:1990), which has been technically revised. The main changes compared to the previous edition are as follows:

— the list of normative references has been revised;

— additional terms and definitions have been added;

— the evaluation of the readability of measuring instruments has been deleted and moved to ISO 9110-1;

— the calibration of working instruments has been deleted and moved to ISO 9110-1;

— the selection and installation of test equipment has been revised and combined and test data acquisition has been renamed as measuring instrument selection;

— total measurement uncertainty has been added.

A list of all parts in the ISO 9110 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Universal and standardized techniques for the measurement of pressure are required for accurate and repeatable evaluation of fluid power systems. The purpose of this document is to present recommended practices for the measurement of average steady-state pressure in hydraulic fluid power systems. This document is intended for use in conjunction with ISO 9110-1.

Hydraulic fluid power — Measurement techniques —

Part 2: Measurement of average steady-state pressure in a closed conduit

1 Scope

This document establishes procedures for measuring the average steady-state pressure in a hydraulic fluid power conduit.

It is applicable to the measurement of average steady-state pressure in closed conduits with inside diameters greater than 3 mm, transmitting hydraulic fluid power with average fluid velocities less than 25 m/s and average steady-state static pressures less than 70 MPa.

It is not applicable to sensors which are flush mounted with, or an integral part of, the closed fluid conduit wall.

It provides the formulae for estimating the total uncertainty in a given pressure measurement.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 5598, *Fluid power systems and components — Vocabulary*

ISO 9110-1, *Hydraulic fluid power — Measurement techniques — Part 1: General measurement principles*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5598 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
tare pressure differential
pressure loss between the pressure tapping points as generated by the test circuit exclusive of the component under test

4 Measuring instrument selection

4.1 The following subclauses shall be evaluated in accordance with ISO 9110-1.

4.2 A complete calibration on measuring instruments which have not been previously calibrated shall be conducted. Gage or absolute pressure instruments are calibrated following established procedures using a traceable reference standard. The reference standard used shall be recorded.

Differential pressure instruments should be calibrated at the line pressures corresponding to their application by pressurizing both instrument ports simultaneously. If bidirectional pressures are to be measured, calibration should encompass both the positive and negative measurement quadrants of the instrument.

If this is not practical or the differential pressure instrument is subject to varying line pressures in the measurement situation, include the maximum expected value of the line pressure effect as a standard uncertainty contributing term in computing the total measurement uncertainty in Clause 7.

Perform an intermediate instrument calibration as required by the measurement class specified.

4.3 Evaluate the readability uncertainty of the readout device to which the measuring instrument is connected or equipped.

4.4 Each measuring instrument shall be described by an uncertainty model, which is derived from the calibration results. Evaluate the calibration uncertainty.

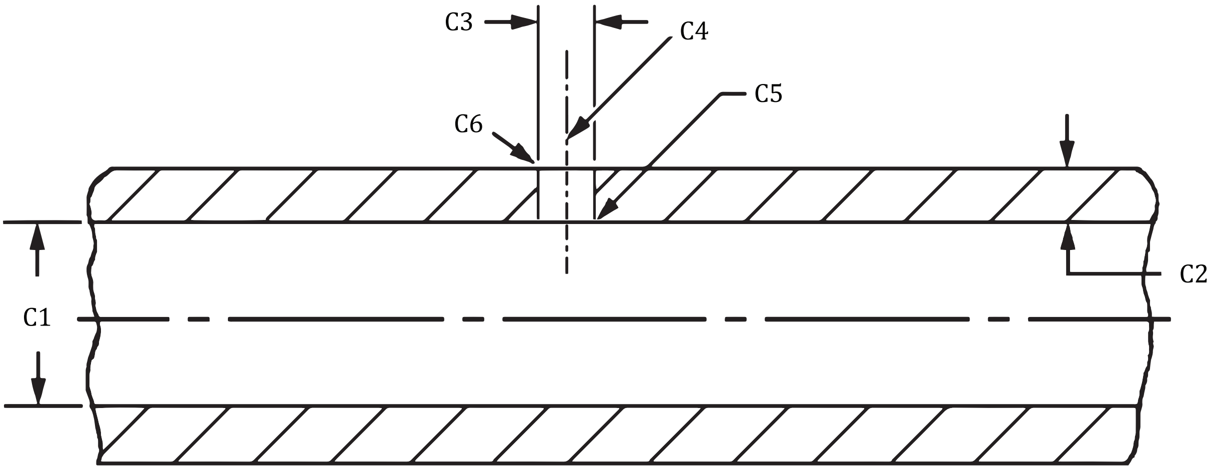
4.5 Each measuring instrument shall be supported by calibration records or calibration database and should have a calibration label attached. See ISO 9110-1:2020, 6.2.12.

4.6 Consider influencing environmental factors in order to minimize their standard uncertainty contribution. Environmental conditions usually limit the usefulness of instruments because they are not designed to operate under diverse operating conditions of temperature, vibration or supply voltage variations, for example. Consider environmental factors carefully since they often are the largest uncertainty contributors.

With knowledge of the instrument operating environment and the instrument manufacturer's specifications, environmental factors can be minimized or evaluated. Either correct for or include the uncertainty contribution of environmental factors in computing the total measurement uncertainty in Clause 7.

5 Pressure taps

5.1 Select and install one of the following types of pressure taps. Types 1 and 2 are constructed in accordance with Figure 1 and Table 1. The Type 3 tap consists of a construction other than Type 1 or 2.



NOTE Drawing is not to scale.

Figure 1 — Pressure tap hole construction

Table 1 — Pressure tap hole construction

Characteristic	Description	Requirement
C1	Inside diameter	Application Specific
C2	Fluid conductor wall thickness	Application Specific
C3	Tap hole diameter	C2 / C3 ≥ 1,5
C4	Tap hole centre line	Centre line of tap hole diameter (C4) shall meet conductor centre line and be normal to it.
C5	Corner radius	Corner radius R_{max} = 1/8 (C3).
C6	Corner break	Break sharp edge

More than one pressure tap hole is permitted, but only one may be used in the measurement situation (not a piezometer ring). The tap hole should not be situated on the lowest point of the fluid conductor when fluid contamination effects are significant. The fabrication technique used for connecting the fitting to the fluid conductor is optional provided the geometric requirements of Figure 1 are adhered to.

a) Type 1 – This tap is constructed by drilling a hole into a straight piece of the fluid conductor and shall be free of all visible burrs.

b) Type 2 – It is constructed in the same manner as Type 1, but either has visible burrs or the interior edge of hole C3 cannot be verified as being free of all visible burrs.

c) Type 3 – It is a tap consisting of a construction other than that described in a) and b). For example, a tap which consists of a commercial type straight fitting, tee, or cross, often used in applications utilizing hose or steel tube conduits to implement a tap, would be classified as Type 3.

