

---

---

**Hydraulic fluid power — Valves  
— Determination of differential  
pressure/flow rate characteristics**

*Transmissions hydrauliques — Distributeurs — Détermination des  
caractéristiques de pression différentielle/débit*

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[ISO 4411:2019](https://standards.iteh.ai/catalog/standards/sist/77aa19e7-bdde-419a-a2b2-b2a5b8b3e798/iso-4411-2019)

[https://standards.iteh.ai/catalog/standards/sist/77aa19e7-bdde-419a-a2b2-  
b2a5b8b3e798/iso-4411-2019](https://standards.iteh.ai/catalog/standards/sist/77aa19e7-bdde-419a-a2b2-b2a5b8b3e798/iso-4411-2019)



## iTeh STANDARD PREVIEW (standards.iteh.ai)

ISO 4411:2019

<https://standards.iteh.ai/catalog/standards/sist/77aa19e7-bdde-419a-a2b2-b2a5b8b3e798/iso-4411-2019>



### **COPYRIGHT PROTECTED DOCUMENT**

© ISO 2019

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Fax: +41 22 749 09 47  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [www.iso.org](http://www.iso.org)

Published in Switzerland

# Contents

	Page
<b>Foreword</b> .....	<b>iv</b>
<b>Introduction</b> .....	<b>v</b>
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>1</b>
<b>3 Terms and definitions</b> .....	<b>1</b>
<b>4 Symbols and units</b> .....	<b>2</b>
<b>5 Test installations</b> .....	<b>2</b>
5.1 Selection, calibration and installation of equipment.....	2
5.2 Test circuit.....	2
5.3 Pressure-tapping points.....	4
<b>6 Test procedures</b> .....	<b>5</b>
6.1 Measurement accuracy.....	5
6.2 Test fluid.....	5
6.3 Temperatures.....	5
6.4 Steady-state conditions.....	5
6.5 Procedure.....	6
6.6 Pressure differential calculation.....	6
6.7 Presentation of the test results.....	6
6.7.1 General.....	6
6.7.2 Presentation.....	6
<b>7 Identification statement (Reference to this document)</b> .....	<b>7</b>
<b>Annex A (informative) Use of practical units</b> .....	<b>8</b>
<b>Annex B (informative) Pre-test checklist</b> .....	<b>9</b>
<b>Bibliography</b> .....	<b>10</b>

## 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](http://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](http://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](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 131, *Fluid power systems*, Subcommittee SC 5, *Control products and components*.

This third edition cancels and replaces the second edition (ISO 4411:2008), which has been technically revised. The main changes compared to the previous edition are as follows:

- “volume flow rate” is replaced with “flow rate”;
- “flow rate symbol  $q_v$ ” is replaced with “ $q$ ”;
- updated and improved quality of [Figure 1](#) and [Figure 2](#).

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](http://www.iso.org/members.html).

## Introduction

In hydraulic fluid power systems, power is transmitted and controlled through a liquid under pressure within an enclosed circuit. Hydraulic valves control the direction, pressure or flow rate of the fluid in the system.

When fluid flows through a valve, it encounters some resistance, which results in a loss of pressure; this loss is called the pressure differential.

This document is intended to unify testing methods for hydraulic fluid power valves to enable the pressure differential/flow characteristics of different valves to be compared.

## iTeh STANDARD PREVIEW (standards.iteh.ai)

[ISO 4411:2019](https://standards.iteh.ai/catalog/standards/sist/77aa19e7-bdde-419a-a2b2-b2a5b8b3e798/iso-4411-2019)

<https://standards.iteh.ai/catalog/standards/sist/77aa19e7-bdde-419a-a2b2-b2a5b8b3e798/iso-4411-2019>

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

ISO 4411:2019

<https://standards.iteh.ai/catalog/standards/sist/77aa19e7-bdde-419a-a2b2-b2a5b8b3e798/iso-4411-2019>

# Hydraulic fluid power — Valves — Determination of differential pressure/flow rate characteristics

## 1 Scope

This document specifies methods for determining, under steady-state conditions, the pressure differential caused by the flow through any given path in a hydraulic fluid power valve. Requirements for test installations, procedures and presentation of results are specified.

## 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 4401, *Hydraulic fluid power — Four-port directional control valves — Mounting surfaces*

ISO 5598, *Fluid power systems and components — Vocabulary*

ISO 5781, *Hydraulic fluid power — Pressure-reducing valves, sequence valves, unloading valves, throttle valves and check valves — Mounting surfaces*

ISO 6263, *Hydraulic fluid power — Compensated flow-control valves — Mounting surfaces*

ISO 6264, *Hydraulic fluid power — Pressure-relief valves — Mounting surfaces*

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

ISO 9110-2, *Hydraulic fluid power — Measurement techniques — Part 2: Measurement of average steady-state pressure in a closed conduit*

ISO 10372, *Hydraulic fluid power — Four- and five-port servovalves — Mounting surfaces*

## 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:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

### 3.1

#### **tare pressure differential**

pressure loss between the pressure-tapping points as generated by the test equipment exclusive of the test valve

### 3.2

#### **measured pressure differential**

measured pressure loss between the pressure-tapping points, including the pressure loss through the test valve and the test equipment

**3.3  
flow rate**

$q$   
rate of flow at the point of measurement

**3.4  
pressure differential**

$\Delta p$   
pressure loss attributed to the test valve

**4 Symbols and units**

4.1 The symbols and units used throughout this document are shown in [Table 1](#).

4.2 The graphical symbols used in [Figures 1](#) to [3](#) are in accordance with ISO 1219-1.

**Table 1 — Symbols and units**

Reference subclause	Quantity	Symbol	Dimension <sup>a</sup>	Unit <sup>b</sup>
<a href="#">3.3</a>	Flow rate	$q$	$l^3t^{-1}$	m <sup>3</sup> /s
<a href="#">3.4</a>	Pressure differential	$\Delta p$	$ml^{-1}t^{-2}$	Pa <sup>c</sup>
—	Inside diameter of tube	$d$	$l$	m
—	Temperature	$\theta$	$\theta$	°C
—	Kinematic viscosity	$\nu$	$l^2t^{-1}$	m <sup>2</sup> /s
—	Mass density	$\rho$	$ml^{-3}$	kg/m <sup>3</sup>

<sup>a</sup>  $m$  signifies mass,  $l$  signifies length,  $t$  signifies time.

<sup>b</sup> The use of practical units for the presentation of results is described in [Annex A](#).

<sup>c</sup> 1 Pa = 1 N/m<sup>2</sup>.

**5 Test installations**

NOTE [Annex B](#) provides a checklist for the selection of appropriate items upon which agreement between the parties concerned is recommended prior to testing.

**5.1 Selection, calibration and installation of equipment**

5.1.1 Equipment shall be selected in accordance with ISO 9110-2.

5.1.2 Calibration shall be carried out in accordance with ISO 9110-1.

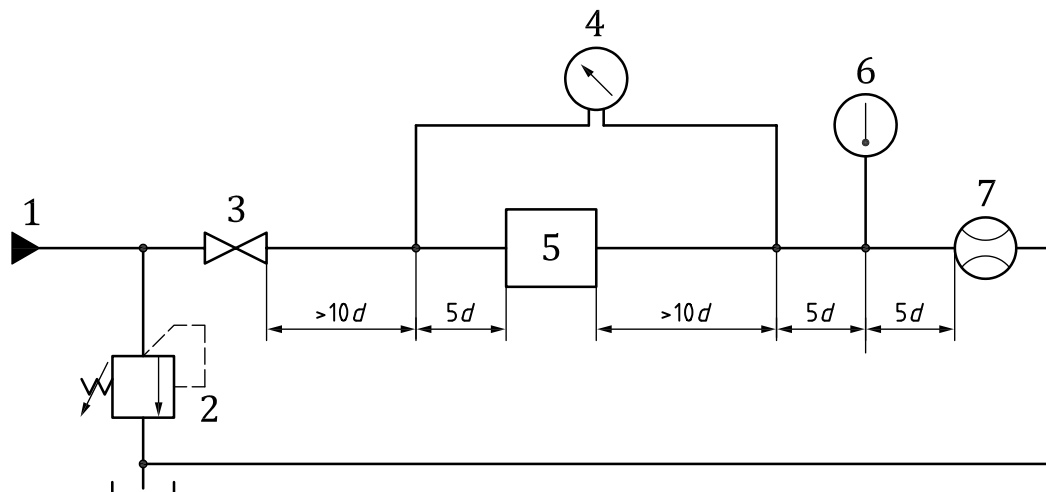
5.1.3 The test set-up shall be in accordance with ISO 9110-2.

**5.2 Test circuit**

5.2.1 A circuit suitable for testing valves as shown in [Figure 1](#) shall be used. The requirements for the position of the pressure-measuring connections and the flow meter shown in [Figure 1](#) and referred to in [5.2.5](#) to [5.2.9](#) apply only to Class A measurement accuracy.

[Figure 1](#) illustrates a basic circuit that does not incorporate all the safety devices necessary to protect against damage in the event of component failure. It is important that those responsible for carrying out the test give due consideration to safeguarding both personnel and equipment.



**Key**

- 1 controllable flow supply, at controlled fluid temperature
- 2 relief valve (circuit protection)
- 3 stop valve (normally fully open)
- 4 differential pressure measuring device
- 5 test valve
- 6 temperature measuring device
- 7 flow meter

iTech STANDARD PREVIEW  
(standards.itech.ai)

**Figure 1 — Test circuit diagram**

ISO 4411:2019

**5.2.2** On subplate-mounted valves and sandwich-mounted valves, measurements should be carried out using standard pressure-tapping plates (intermediate plates) as shown in [Figure 2](#). In this case, the requirements given in [5.2.5](#) to [5.2.8](#) and [5.3](#) do not apply.

Dimension *A* shall be the maximum port size specified in ISO 4401, ISO 5781, ISO 6263, ISO 6264 or ISO 10372 for the valve being tested.

Dimension *B* shall be appropriate for the selected interface O-ring.

The threaded port size shall be appropriate for the flow rating of the valve.

Only one port is shown, which would be typical for P, T, A and B ports.