
**Hydraulic fluid power — Filters —
Evaluation of differential pressure
versus flow**

*Transmissions hydrauliques — Filtres — Évaluation de la perte de
charge en fonction du débit*

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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).

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For an explanation on 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 the following URL: www.iso.org/iso/foreword.html. (standards.iteh.ai)

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This third edition cancels and replaces the second edition (ISO 3968:2001), which has been technically revised. It also incorporates the Technical Corrigendum ISO 3968:2001/Cor1:2002.

Introduction

In hydraulic fluid power systems, power is transmitted and controlled through a fluid under pressure circulating within a closed circuit. Filters maintain the cleanliness of the fluid by retaining the insoluble contaminants.

Hydraulic filters normally include a housing that serves as the pressure-containing vessel to direct the flow of fluid through a filter element that separates contaminants from the test fluid.

This document foresees the possibility to test spin-on filters in which the replaceable unit does or does not include a filter head.

In operation, fluid flowing through a filter meets resistance due to kinetic and viscous effects. The pressure required to overcome this resistance and to maintain flow is known as the differential pressure. The differential pressure is the total pressure difference observed between the filter inlet port and outlet port and represents the sum of the losses recorded in the housing and filter element.

Factors which affect clean filter differential pressure are fluid viscosity, fluid specific gravity, flow rate, filter element media type and construction, as well as housing design.

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Hydraulic fluid power — Filters — Evaluation of differential pressure versus flow

1 Scope

This document specifies a procedure for evaluating differential pressure versus flow characteristics of hydraulic filters and constitutes a basis for agreement between the filter manufacturer and user.

It also specifies a method for measurement of the differential pressure generated at different flow rates and viscosities by the relevant parts of a filter assembly, spin-on and any valves contained within the filter which are in the flow stream. The typical types of filter to be tested are as follows:

Type 1: which are spin-on filters in which the replaceable unit does not include a filter head (it might or might not include the element by-pass valve);

Type 2: which are spin-on filters in which the replaceable element is tested together with a filter head (it might or might not include the element by-pass valve);

Type 3: which are filter assembly, usually of the replacement element type, that is the housing (head and bowl) and element.

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2 Normative references (standards.iteh.ai)

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 2909, *Petroleum products — Calculation of viscosity index from kinematic viscosity*

ISO 3448, *Industrial liquid lubricants — ISO viscosity classification*

ISO 3675, *Crude petroleum and liquid petroleum products — Laboratory determination of density — Hydrometer method*

ISO 4021, *Hydraulic fluid power — Particulate contamination analysis — Extraction of fluid samples from lines of an operating system*

ISO 4406, *Hydraulic fluid power — Fluids — Method for coding the level of contamination by solid particles*

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

ISO 6415, *Internal combustion engines — Spin-on filters for lubricating oil — Dimensions*

3 Terms and definitions

For the purposes of this document, the 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 <http://www.electropedia.org/>

— ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1

filter rated flow rate

flow rate recommended by the filter manufacturer for a specified kinematic viscosity

**3.2
viscosity index**

empirical measure of the viscosity/temperature characteristics of a fluid

Note 1 to entry: The smaller the change in viscosity within a given temperature range, the higher the viscosity index.

**3.3
differential pressure**

difference between the tested component inlet and outlet pressures under specified conditions

**3.4
rest conductivity**

electrical conductivity at the initial instant of current measurement after a DC voltage is impressed between electrodes

Note 1 to entry: It is the reciprocal of the resistance of uncharged fluid in the absence of ionic depletion or polarization.

4 Symbols

4.1 Letter symbols

The letter symbols used in this document are shown in [Table 1](#).

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Table 1 — Letter symbols
(standards.iteh.ai)

Symbol	Unit	Description or explanation
q_v	litres per minute	Test flow rate
q_R	litres per minute	Filter rated flow rate
p	kilopascals	Static pressure
p_1	kilopascals	Static pressure measured upstream of the filter
p_2	kilopascals	Static pressure measured downstream of the filter
Δ_p	kilopascals	Differential pressure ($\Delta_p = p_1 - p_2$)
D	millimetre	Internal pipe diameter

4.2 Graphical symbols

The graphical symbols used in this document are in accordance with ISO 1219-1.

5 Operational characteristics to be tested

Filters installed on a closed circuit generate a pressure drop that reduces the effective oil pressure available to the working parts.

In order to ensure an adequate oil pressure to the working parts, it is customary for the filter to be designed to pass its full rated flow with no more than a specified differential pressure. The tests specified in this document measure the differential pressure across a complete filter, in a clean condition, over the whole range of oil flow rates.

The differential pressure across the filter is due to the pressure at the inlet and outlet of the filter, including any casting or adaptor which is part of the filter assembly, and at the anti-drain back valve, if one is fitted, as well as to the differential pressure across the filter element itself. For some purposes, it is necessary to know the differential pressure across the filter alone, for example in assessing the performance of the element in the case of some combinations of filter medium and contaminant. In

addition to the tests indicated above, the tests specified measure the differential pressure across a clean filter element over the whole range of oil flow rates.

6 Filter to be tested

6.1 Filter type

6.1.1 Type 1: spin-on filters in which the replaceable unit does not include a filter head (it might or might not include the element by-pass valve).

6.1.2 Type 2: spin-on filters in which the replaceable element is tested together with a filter head (it might or might not include the element by-pass valve).

6.1.3 Type 3: filter assembly, usually of the replacement element type, that is the housing (head and bowl) and element.

6.2 Filter element

The filter element for the test shall be unused. Test liquid and the test rig shall be cleaned in accordance with [9.2](#).

7 Test equipment ITeH STANDARD PREVIEW

7.1 General indications (standards.iteh.ai)

A suitable test rig consists of a pump, a reservoir, a clean-up filter, the filter under test and, if required, a heat exchanger and appropriate heat source for temperature control, together with all the necessary equipment for measuring the pressure, the flow rate, the temperature and the fluid cleanliness level (see [8.5](#)). [Figure 1](#) shows a typical test rig in schematic form.

The test rig shall be constructed so that it does not contain dead legs or zones or quiescent areas where contaminant can settle out and re-entrain later during the test.

When testing return filters to be half-immersed in the reservoir, the test equipment located downstream of the test filter in [Figure 1](#) [flow meter, heat exchanger (counter pressure valve is not necessary)] shall be located upstream of the test filter.

7.2 Pump

Use a pump with a flow rate equal to or greater than the maximum flow rate required for the test. The delivery pressure shall be sufficient for pumping the required flow through the filter under test and for supplying simultaneously the clean-up filter and the remainder of the rig. A device shall make it possible to continuously vary the flow rate from zero to maximum. Pressure ripple shall be suppressed, if required, to guarantee pressure readings with the required accuracy.

7.3 Reservoir

Use a reservoir with a conical bottom; minimum volume expressed in litres should be equal to the maximum flow rate in litres per minute scheduled for the test. It should be designed to eliminate air entrainment (for example, by means of a return of the fluid beneath the test fluid surface) and ingress of airborne contamination.

NOTE Lower volumes increase the likelihood of air entrainment.

7.4 Temperature control

Use a heat exchanger and appropriate heat source to control the temperature measured upstream of the filter under test to the required value with an accuracy conforming to [Table 2](#).

7.5 Clean-up filter

Use a clean-up filter with a filtration ratio (see ISO 16889) greater than that of the filter under test, so that no measurable increase in differential pressure of the filter under test due to partial blocking can occur.

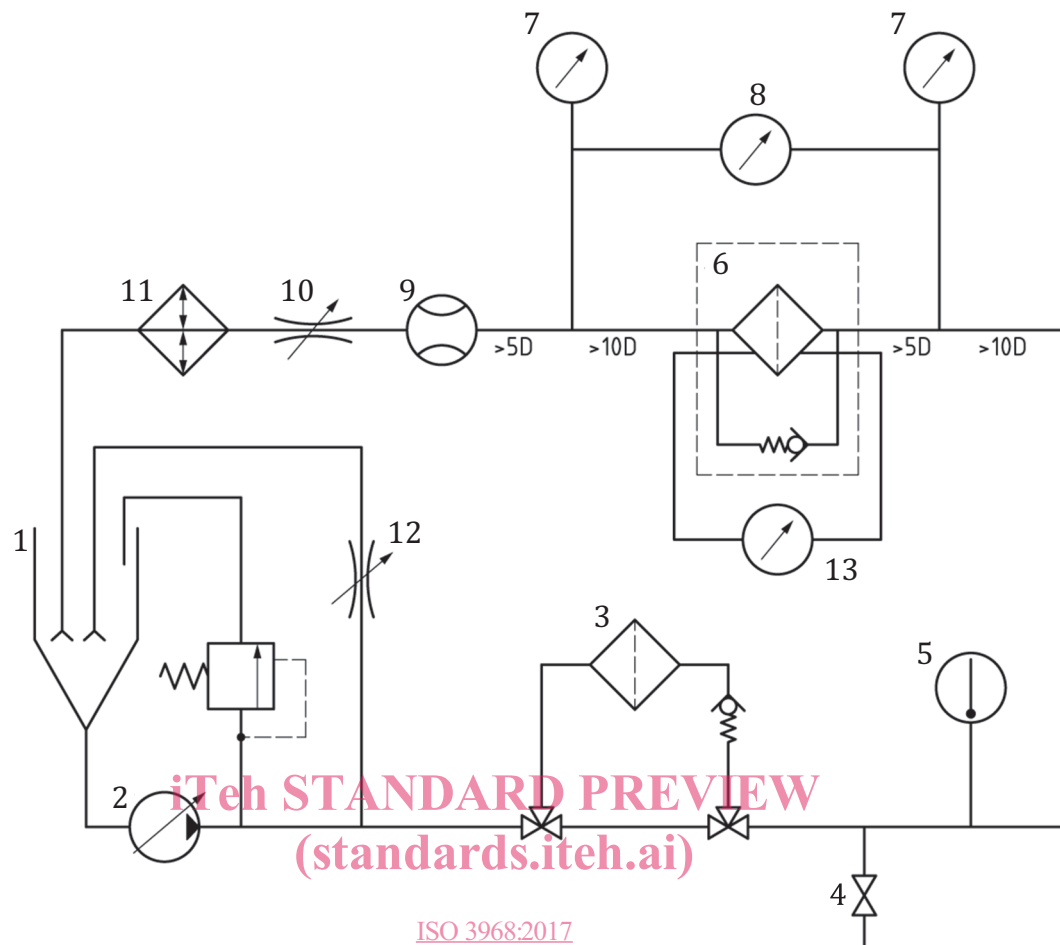
7.6 Sampling valve

To verify fluid cleanliness, equip the circuit with a sampling valve in accordance with ISO 4021. The sample point shall allow connection of an online monitor or extraction of a fluid sample for off-line analysis.

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Key

1	reservoir	8	differential pressure transducer or two single pressure transducers to measure the differential pressure
2	variable flow pump	9	flow meter
3	clean-up filter	10	counter pressure regulating valve
4	sampling valve	11	heat exchanger
5	thermometer	12	bypass flow regulating valve
6	filter under test	13	differential pressure transducer or two single pressure transducers to measure the differential pressure across the spin-on filter - element
7	absolute pressure transducer		

Figure 1 — Example of a test circuit suitable for measuring the differential pressure versus flow rate characteristics of filter assemblies and spin-on filters

7.7 Mounting of filter

7.7.1 In the case of the types of filter indicated in [6.1.1](#), a special test head is required and a typical example is shown in [Figure 2](#). The differential pressure across the complete filter assembly or element shall be measured in accordance with [8.1.1](#).

7.7.2 In the case of the types of filter indicated in [6.1.2](#) and [6.1.3](#), mount the filter on the test rig in the normal orientation. Use the correct sizes of standard unions to connect the filter. Use pipes between the filter and the pressure measuring points maintaining the same internal diameters as the unions. Take the differential pressure across the filter in accordance with [8.1.2](#).