INTERNATIONAL STANDARD

ISO 4548-1

First edition
1997-09-15

Methods of test for full-flow lubricating oil filters for internal combustion engines —

Part 1:
Differential pressure/flow characteristics

Méthodes d'essai des filtres à huile de lubrification à passage intégral pour moteurs à combustion interne —

Partie 1: Caractéristique débit/pression différentielle

Reference number
ISO 4548-1:1997(E)

Contents

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet central@iso.ch
X.400 c=ch; a=400net; p=iso; o=isocs; s=central

Printed in Switzerland

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.

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.

International Standard ISO 4548-1 was prepared by Technical Committee ISO/TC 70, *Internal combustion engines*, Subcommittee SC 7, *Tests for lubricating oil filters*.

This second edition cancels and replaces the first edition (ISO 4548-1:1982), which has been technically revised.

ISO 4548 consists of the following parts, under the general title *Methods of test for full-flow lubricating oil filters for internal combustion engines*:

— *Part 1: Differential pressure/flow characteristics*

— *Part 2: Element by-pass valve characteristics*

— *Part 3: Resistance to high differential pressure and to elevated temperature*

— *Part 4: Initial particle retention efficiency, life and cumulative efficiency (gravimetric method)*

— *Part 5: Cold start simulation and hydraulic pulse durability test*

— *Part 6: Static burst pressure test*

— *Part 7: Vibration fatigue test*

— *Part 9: Inlet and outlet anti-drain valve tests*

— *Part 10: Life and cumulative efficiency in the presence of water in oil*

— *Part 11: Self-cleaning filters*

— *Part 12: Particle retention ability and contaminant holding capacity using particle counting*

Annex A of this part of ISO 4548 is for information only.

Introduction

ISO 4548 establishes standard test procedures for measuring the performance of full-flow lubricating oil filters for internal combustion engines. It has been prepared in separate parts, each part relating to a particular performance characteristic.

Together the tests provide the information necessary to assess the characteristics of a filter, but if agreed between the purchaser and the manufacturer, the tests may be conducted separately.

This revision of this part of ISO 4548 has been undertaken in order to align the presentation with the requirements of the current ISO Directives. The principal changes are editorial, affecting the layout and the text. Minor technical changes comprise the inclusion of ISO VG and SAE oil grades for the test liquids, and revision of the test rig dimensions to make them consistent with those specified in ISO 3968. In addition, the flow meter on the test rig has been repositioned downstream of the throttle valve.

Methods of test for full-flow lubricating oil filters for internal combustion engines —

Part 1:
Differential pressure/flow characteristics

1 Scope

This part of ISO 4548 specifies tests for determining the differential pressure/flow characteristics of full-flow lubricating oil filters for internal combustion engines.

Tests are specified with oils at two viscosities, one to assess the performance of a filter with a cold oil and the other to assess its performance with an oil at a typical operating temperature.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 4548. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreement based on this part of ISO 4548 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 1219-1:1991, *Fluid power systems and components — Graphic symbols and circuit diagrams — Part 1: Graphic symbols.*

ISO 11841-1:—[1], *Road vehicles and internal combustion engines — Filter vocabulary — Part 1: Definitions of filters and filter components.*

ISO 11841-2:—[1], *Road vehicles and internal combustion engines — Filter vocabulary — Part 2: Definitions of characteristics of filters and their components.*

3 Definitions

For the purposes of this part of ISO 4548, the definitions given in ISO 11841-1 and ISO 11841-2 apply.

4 Graphical Symbols

The graphical symbols used in this part of ISO 4548 are in accordance with ISO 1219-1.

5 Operational characteristics to be tested

A full-flow lubricating oil filter in an internal combustion engine, interposed between the oil pump and the working parts of the engine, necessarily reduces the effective oil pressure available to the engine below the pressure delivered by the pump.

1) To be published.

In order to ensure an adequate oil pressure to the engine, 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 part of ISO 4548 measure the differential pressure across a complete filter assembly, in a clean condition, over the whole range of oil flow rates.

The differential pressure across the complete 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

For the purpose of mounting the filter under test in the test rig, the following types of filter are recognised:

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

b) spin-on filters in which the replaceable unit incorporates a filter head that includes the element by-pass valve;

c) other filters, usually of the replacement element type and usually including their own filter head.

6.2 Filter element

The filter element for the test shall be unused and the test liquid and the test rig shall be clean. For the purposes of this part of ISO 4548, the term "clean" means that there is no detectable increase in differential pressure across a filter of the type under test when the test liquid at the test temperature is circulated through the test rig and the filter, at the rated flow of the filter, for 5 min.

7 Test rig

The test rig is shown diagrammatically in figure 1. It shall include the components described in 7.1 to 7.4, together with the necessary tubing, connectors and supports.

7.1 Sump

The sump shall be capable of holding sufficient oil and shall be equipped with a thermostatically controlled heater and cooler capable of maintaining the test temperature. The heater shall be arranged so that local overheating of the oil is avoided. The by-pass return to the sump and the filter outlet pipe shall terminate below the surface of the oil in the sump when the oil is in circulation. The temperature shall be arranged so that the stipulated viscosity is maintained.

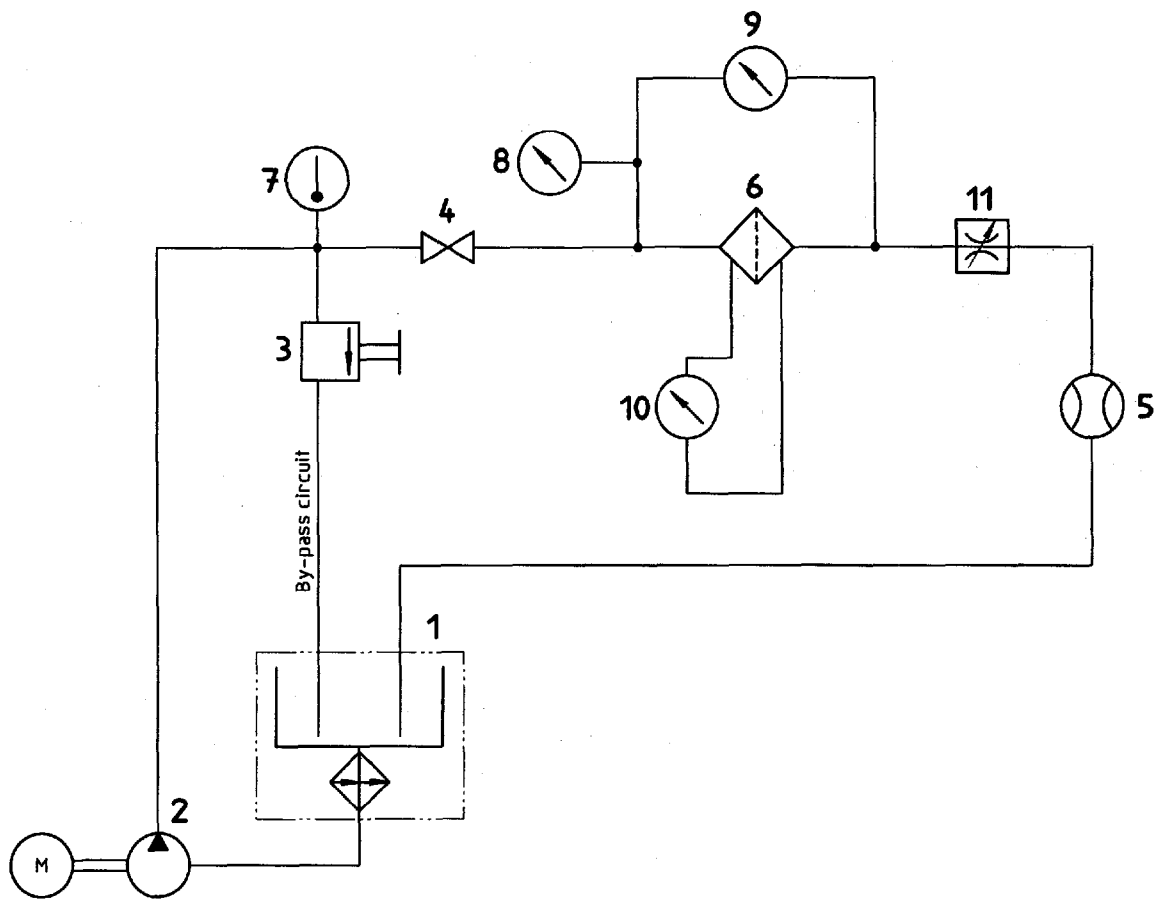
7.2 Regulating valves

The regulating valves, **3** and **11,** shall be used for the purposes of pressure and flow control. Needle valves of diaphragm type valves are recommended.

7.3 Flow meter

The flow meter shall be suitable for use with oils of 24 mm^2/s [2)] and 500 mm^2/s kinematic viscosity and shall register the flow in the pipeline leading to the filter. As an alternative, the flow meter may be installed at the filter outlet pipe. A calibrated measuring vessel and stop watch may be used.

2) 1 mm^2/s = 1 cSt



Key

1 Sump (preferably insulated) incorporating a thermostatically controlled heater and cooler

2 Motor-driven pump

3 Throttle valve (for pressure regulation)

4 ON-OFF valve

5 Flow meter

6 Filter under test

7 Temperature sensor connected to a temperature indicator

8 Pressure gauge

9 Differential pressure gauge or two single pressure gauges to measure the differential pressure across the filter

10 Differential pressure gauge or two single pressure gauges to measure the differential pressure across the filter element

11 Throttle valve (for flow regulation)

Figure 1 — Diagrammatic arrangement of test rig

7.4 Filter mounting

7.4.1 In the case of the types of filter indicated in 6.1 a), a special test head will be required, and a typical example is shown in figure 2. The differential pressure across the complete filter assembly shall be measured using the pressure tappings marked A and B with C removed. The differential pressure across the filter element shall be measured using an inlet pressure tapping made into the casing surrounding the filter element and the outlet pressure probe marked C.

7.4.2 In the case of the types of filter indicated in 6.1 b) and 6.1 c), the inlet and outlet pipe bores shall be equivalent to the sizes of the inlet and outlet ports of the filter. Alternatively, the sizes of the inlet and outlet pipes shall be as agreed between the manufacturer and the purchaser of the filter, for example to match the ports in the engine block on which the filter is to be used.

Tappings for the measurement of the differential pressure across the complete filter shall be made at five internal pipe diameters upstream of the filter inlet port and ten internal pipe diameters downstream from the filter outlet port. The inlet and outlet pipes shall be straight and free from obstruction for eight internal pipe diameters upstream and 13 internal pipe diameters downstream of the filter inlet and outlet ports.

7.4.3 In the case of the types of filter indicated in 6.1 b) and 6.1 c), tappings for the measurement of the differential pressure across the filter element shall be made into the test filter in communication with the upstream and downstream sides of the filter element. Wherever practicable these tappings shall be positioned to measure the pressure in locations within the filter where the flow is at a low rate and not turbulent. Alternatively, a special test housing may be used for the measurement of the differential pressure across the filter element; a typical housing is shown in figure 3.

8 Test liquids

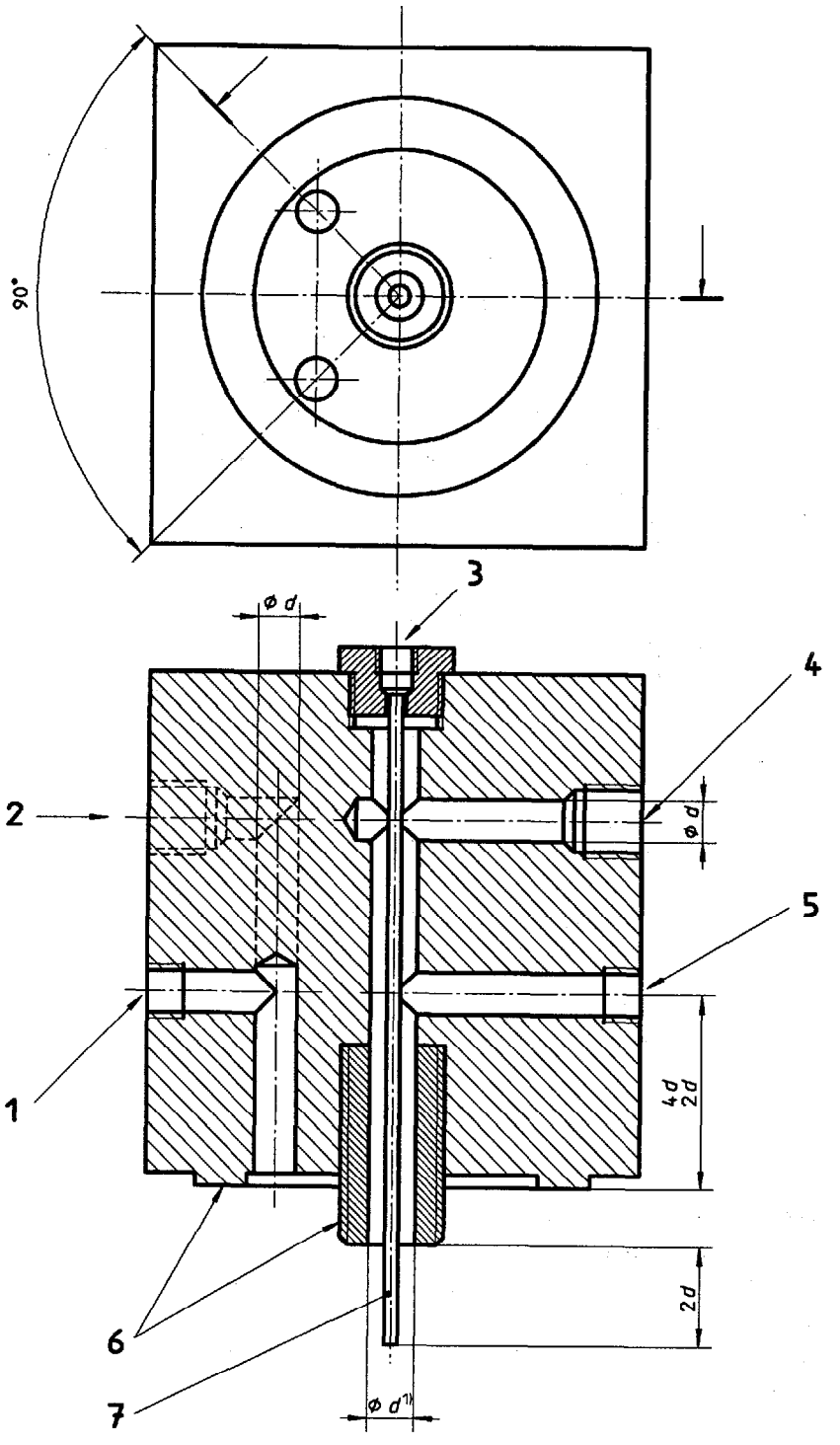
Unless otherwise agreed between the manufacturer and the purchaser of a filter, lubricating oils shall be selected and used in the tests at a suitable temperature to produce kinematic viscosities of 24 mm^2/s for simulating general operating conditions and of 500 mm^2/s when simulating cold conditions of operation. The temperature of the oils shall not exceed 100 °C.

NOTE 1 In order to achieve these viscosities it may be necessary to use two different oils.

A viscosity of 24 mm^2/s can be achieved with ISO VG 100 (SAE 30) oil (see [1] and [4]) at an approximate temperature of 74 °C or ISO VG 150 (SAE 40) oil at an approximate temperature of 83 °C.

A viscosity of 500 mm^2/s can be achieved with ISO VG 460 (SAE 140) oil (see [1] and [4]) at an approximate temperature of 38 °C.

NOTE 2 Intermingling of the two designated test oils may take place, particularly when alternating their use in the same test equipment. The magnitude of the resultant viscosity shift should be closely monitored and compensation made for changes by altering the test temperature or by complete replacement of the test oils.



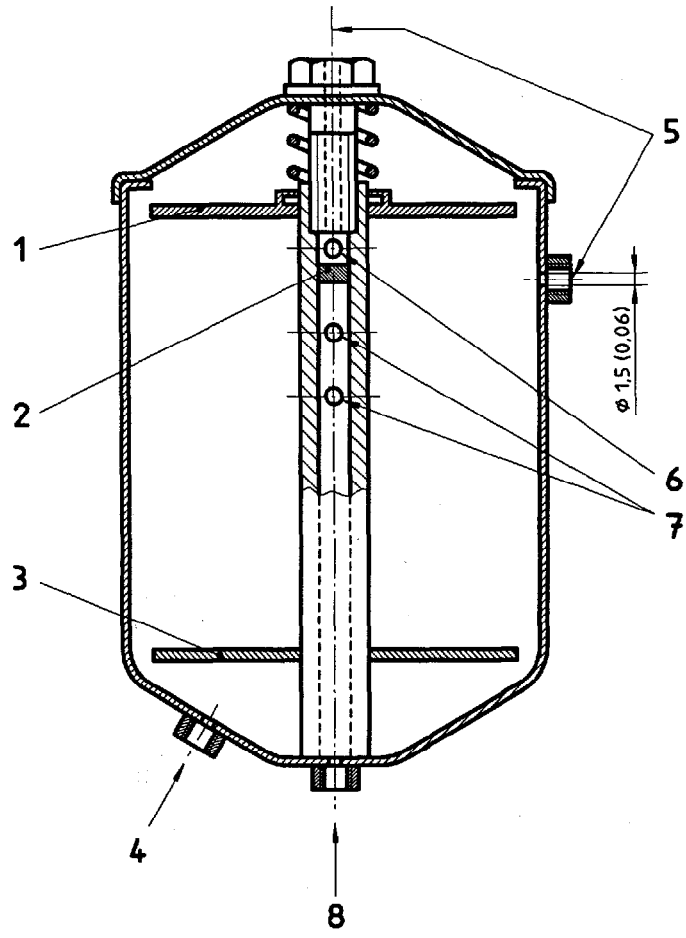
Key

1 Inlet pressure tapping "A" made directly to inlet annulus
2 Inlet connection
3 Filter element outlet pressure tapping "C"
4 Outlet connection
5 Outlet pressure tapping "B"
6 Face dimensions and thread in accordance with ISO 6415, or to suit filter under test
7 Tube Ø 3 mm outside, Ø 1,5 mm inside

1) d = 10 mm, 14 mm, 24 mm or 28 mm depending on diameter of filter outlet.

Figure 2 — Typical special test head for spin-on cartridge filters in which the replaceable unit does not include a filter head

Dimensions in millimetres (inches)



Key

1 Top sealing plate must seal around centre tube
2 Liquid tight plug in centre tube
3 Sealing plate must be attached to centre tube with liquid tight joint
4 Inlet
5 Tappings for measurement of differential pressure across filter element
6 Holes deburred
7 Area of holes in centre tube at least equal to 1,5 times the free area of inlet connections
8 Outlet

Figure 3 — Typical test housing

9 Accuracy of test condition measurements

Measurement of the test conditions shall be maintained within the levels of accuracy given in table 1. Differential pressures shall be measured in kilopascals (kPa).

Table 1 — Measurement accuracies

Condition	Accuracy %
Differential pressure	± 5
Oil viscosity	± 5
Oil flow	± 2

10 Test procedure

10.1 Test of the complete filter

10.1.1 Install the filter under test as shown in figure 1.

10.1.2 Add the required quantity of clean test liquid to the sump **1** and circulate it through the test rig via the by-pass pipe only. No test liquid shall pass through the filter at this stage.

10.1.3 Switch on the heater or cooler and adjust the thermostat to the required temperature (see clause 8). Allow the temperature to become stabilized.

10.1.4 When the temperature of the oil in the sump **1** has become stabilized, pass the test liquid through the filter under test at approximately 50 % of its rated flow. Allow the temperature to become stabilized again. Bleed the system, if necessary.

10.1.5 When the temperature indicator **7** shows that the temperature of the oil at the filter inlet has become stabilized at the required value, take measurements of the differential pressure across the filter, at each of at least four flow rates (eight preferred) at approximately equal increments between 10 % and 110 % of the filter rated flow. Obtain the required flow by adjustment of the pressure and flow regulating valves, **3** and **11**, ensuring that the inlet pressure exceeds the indicated differential pressure so that a positive pressure is maintained at the filter outlet. Hold the flow constant until the pressure is stabilized before taking each reading of differential pressure.

10.1.6 Carry out the procedure described in 10.1.3 to 10.1.5 for each viscosity oil.

10.2 Test of the filter element

If the differential pressure across the filter element is required, a separate test shall be conducted using the test procedures described 10.1.1. to 10.1.6 Mounting of the filter shall be in accordance with 7.4.1or 7.4.3, as appropriate to the type of filter.

11 Report of test results

A typical test report is given in figure 4. It shall include a graph showing, for each viscosity, the differential pressure across the complete filter and the differential pressure across the filter element with respect to flow rate.

Report on filter differential pressure flow test

a) Testing establishment: .....

b) Filter type:

manufacturer .....

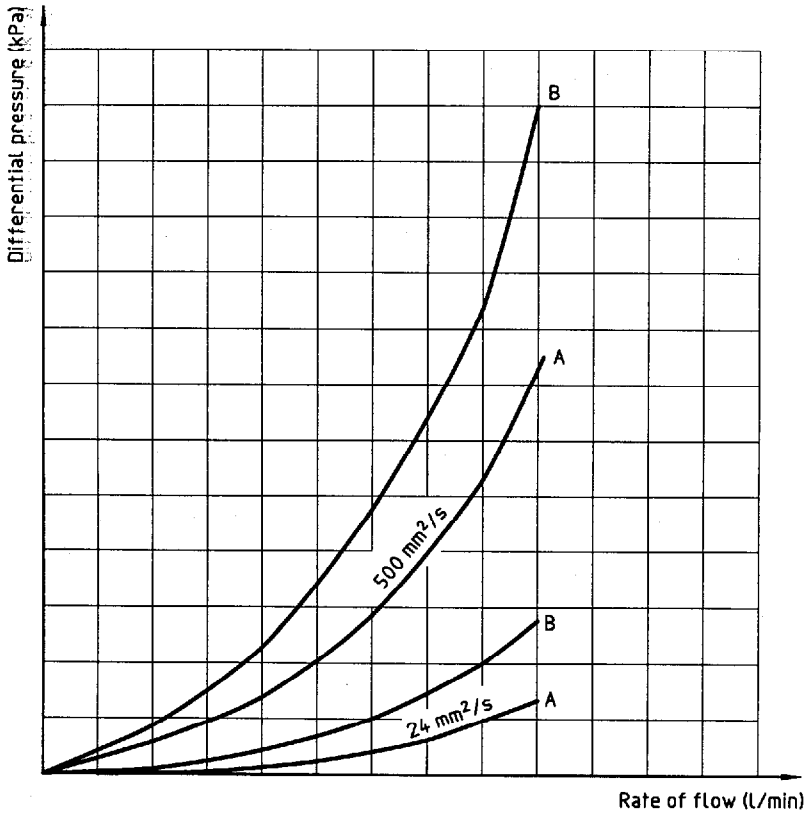
model number and/or batch number (as appropriate) .....

c) Date(s) of tests: .....

d) Test liquid [24 mm^2/s] ..... (designation) at ..... °C

Test liquid [500 mm^2/s] ..... (designation) at ..... °C

e) Graph of variations



A Filter element

B Complete filter

Figure 4 — Example of a test report

Annex A
(informative)

Bibliography

[1] ISO 3448:1992, *Industrial liquid lubricants — ISO viscosity classification.*

[2] ISO 3968:1981, *Hydraulic fluid power — Filters — Evaluation of pressure drop versus flow characteristics.*

[3] ISO 6415:1990, *Internal combustion engines — Spin-on filters for lubricating oil — Dimensions.*

[4] ANSI/SAE J300-MAR93, *Engine oil viscosity classification.*

ICS 27.020

Descriptors: internal combustion engines, lubrication systems, oil filters, tests, performance tests, test report sheets.

Price based on 9 pages