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

Part 3:

**Resistance to high differential pressure and to
elevated temperature**

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

*Partie 3: Résistance aux pressions différentielles élevées et aux hautes
températures*



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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.

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 4548-3 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 4548-3:1982), 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 addition of details of a grade of oil to achieve the required viscosity of test liquid for testing the ability of a filter to withstand high differential pressure, 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.

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

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

1 Scope

This part of ISO 4548 specifies tests for measuring the resistance to high differential pressure and the resistance to elevated temperatures of filter elements of full-flow lubricating oil filters for internal combustion engines.

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 2942:1994, *Hydraulic fluid power — Filter elements — Verification of fabrication integrity and determination of the first bubble point.*

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

Filters can be subjected to high differential pressures in service, particularly as choking takes place with age. They can also be affected by high operating temperatures. This test confirms the ability of a filter element to withstand a specified differential pressure without failure following conditioning at a simulated operating temperature.

1) To be published.

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 an element by-pass valve);
- b) spin-on filters in which the replaceable unit incorporates a filter head that includes an element by-pass valve;
- c) other filters, usually of the replacement element type and usually including their own filter head.

6.2 Filter element

Prior to the test, and unless it is impractical to dismantle the filter assembly, the integrity of the filter element shall be checked in accordance with ISO 2942.

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 **10**, shall be used for the purposes of pressure and flow control. Needle valves or diaphragm type valves are recommended.

7.3 Flow meter

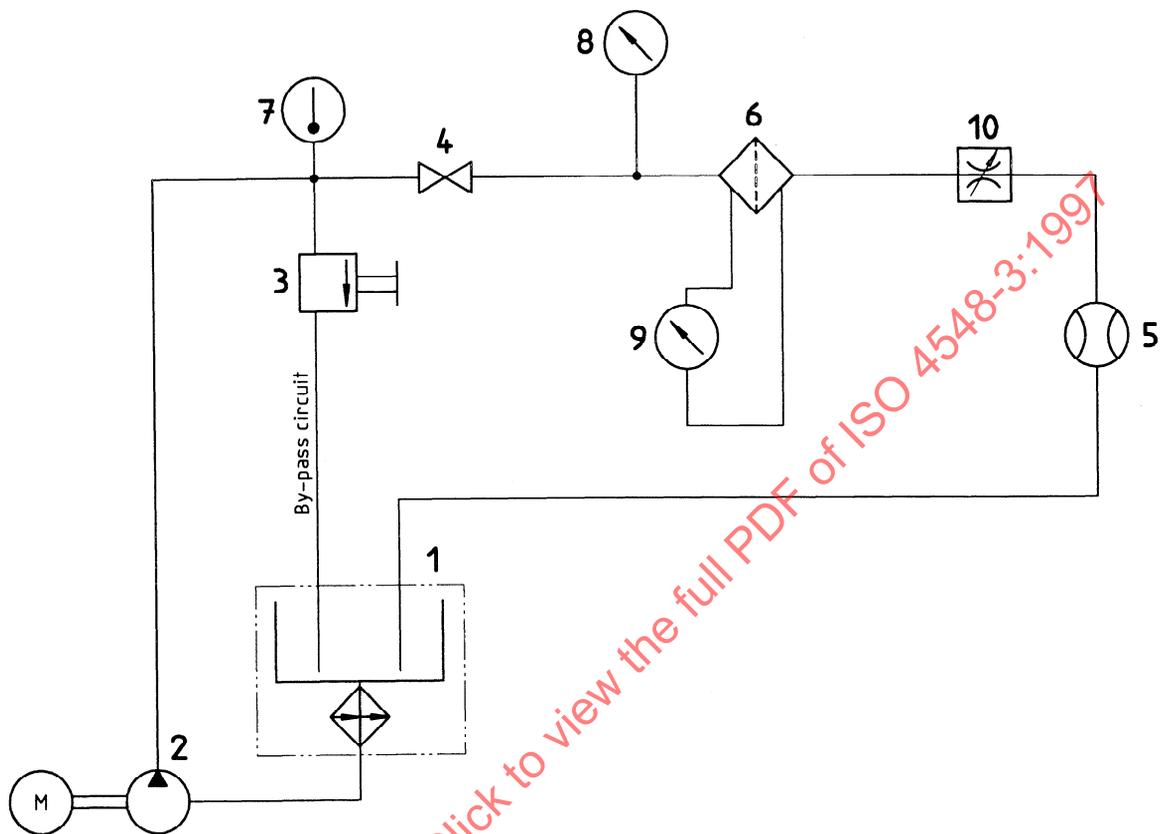
The flow meter shall be suitable for use with oil of $500 \text{ mm}^2/\text{s}^2$ kinematic viscosity and shall register the flow in the pipeline leading to the filter. As an alternative, the flow meter may be installed in the filter outlet pipe.

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 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.

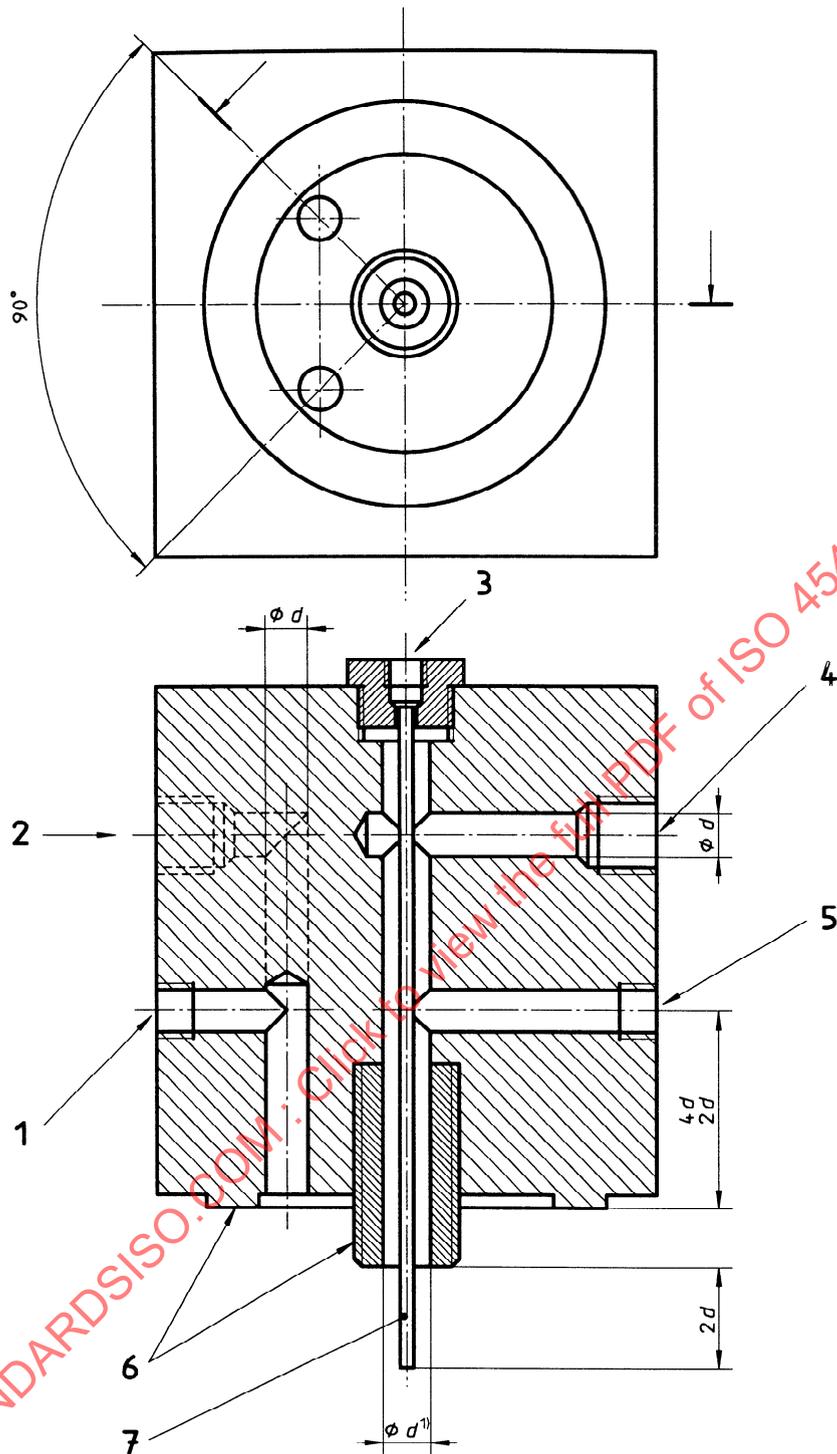
7.4.2 In the case of the types of filter indicated in 6.1 b) and 6.1 c), tappings for the measurement of the differential pressure across the filter element shall be made into the test filter in communication with the upstream and downstream sides of the filter element. Wherever practicable these tappings 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.

2) $1 \text{ mm}^2/\text{s} = 1 \text{ cSt}$

**Key**

- | | | | |
|---|---|----|--|
| 1 | Sump (preferably insulated) incorporating a thermostatically controlled heater and cooler | 7 | Temperature sensor connected to a temperature indicator |
| 2 | Motor-driven pump | 8 | Pressure gauge for measuring the filter inlet pressure |
| 3 | Throttle valve (for pressure regulation) | 9 | Differential pressure gauge or two single pressure gauges to measure the differential pressure across the filter element |
| 4 | ON-OFF valve | 10 | Throttle valve (for flow regulation) |
| 5 | Flow meter | | |
| 6 | Filter under test | | |

Figure 1 — Diagrammatic arrangement of test rig



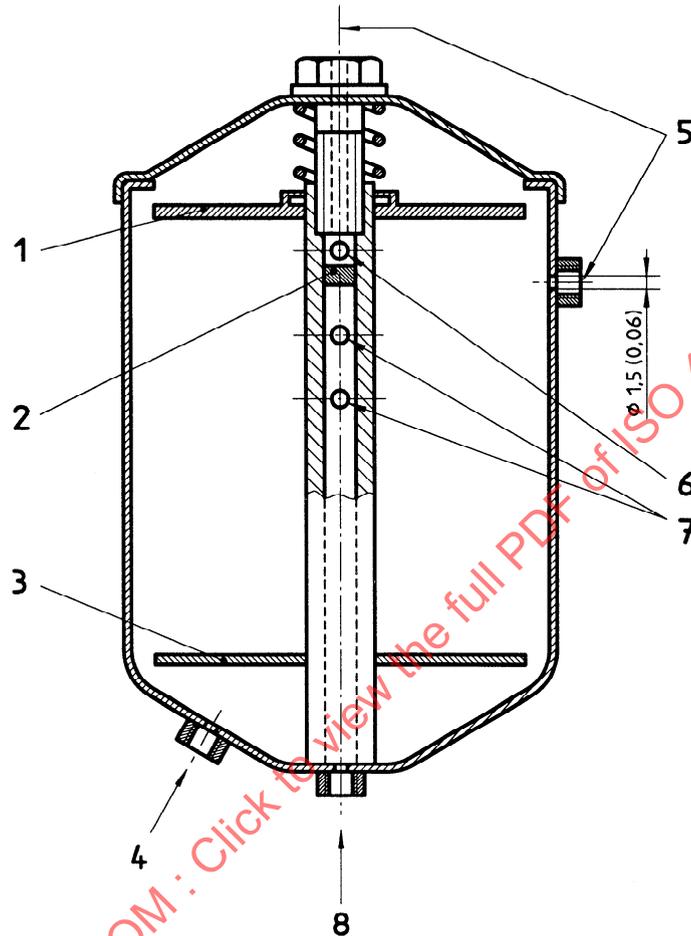
Key

- 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 ϕ 3 mm outside, ϕ 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

8 Test liquids

8.1 Test liquids for test of ability to withstand high differential pressure

A lubricating oil shall be selected and used in the test at a suitable temperature to produce a kinematic viscosity of 500 mm²/s. The temperature of the oil shall not exceed 100 °C.

NOTE — A viscosity of 500 mm²/s can be achieved with ISO VG 460 (SAE 140) oil (see [1] and [3]) at an approximate temperature of 38 °C.

8.2 Test liquid for test of ability to withstand elevated temperature

Unless otherwise agreed between the manufacturer and the purchaser of a filter, a recognised reference oil³⁾ shall be used in the test.

NOTE — The degree and nature of the embrittlement of a filter element exposed to elevated temperatures may be affected by interaction between the material of the element and the oil with which it is used. It may therefore be desirable to compare this characteristic of filter elements using only the oil with which they are to be used in service. However, the results of such tests are valid only as a means of comparing filter elements when that oil is used.

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 for ability to withstand high differential pressure

NOTE — The test should be conducted on an unused filter element.

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

10.1.2 Add the required quantity of clean test liquid (see 8.1) 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 8.1). Allow the temperature to become stabilised.

3) Suitable reference oils include those known as RFO 3 in the USA, and M.I.R.A. Reference Oil No. 2 in the UK.

10.1.4 When the temperature of the oil in the sump 1 has become stabilised, direct the flow of oil to the filter element and increase the flow until the differential pressure across the element is 175 kPa. Then increase the flow so that the differential pressure rises in increments of 25 kPa until it reaches the value 350 kPa, or such other value as is agreed between the manufacturer and the purchaser of the filter. Maintain each differential pressure for 1 min.

Carry out the procedure without exceeding the rated flow of the filter. Unless the required differential pressure can be achieved with clean test fluid, add a quantity of contaminant⁴⁾ to the fluid to partially choke the filter element.

NOTE — The quantity of contaminant should be such that it does not influence the strength of the filter element.

10.1.5 Terminate the test before the required differential pressure is reached if the differential pressure ceases to rise with increasing flow or if a sudden decrease of differential pressure is observed.

After completion of the test, remove the element from its housing, drain the surplus oil from it, and inspect it for failure (see 11.1). Unless the fracture is visibly obvious, test the integrity of the filter element in accordance with ISO 2942.

10.2 Test for ability to withstand elevated temperature.

10.2.1 Drain from the filter assembly any surplus oil remaining in it from the previous tests.

10.2.2 Totally immerse the filter assembly in a container of test oil (see 8.2), taking care to avoid air bubbles being trapped in it.

10.2.3 Place the container in an oven thermostatically controlled to maintain an oil temperature of 135 ± 2 °C unless otherwise agreed by the purchaser and the manufacturer. Expose the filter to that temperature for 96 h.

10.2.4 Remove the container from the oven and allow the filter to cool to a temperature not exceeding 40 °C.

10.2.5 Drain the filter of oil without dismantling.

10.2.6 Repeat the test described in 10.2.2 to 10.2.5.

NOTE — When agreed upon between the manufacturer and purchaser of a filter, the hot oil soak may be extended beyond 192 h.

10.2.7 Subject the filter assembly to the test procedure specified in 10.1.1 to 10.1.5.

11 Report of test results

11.1 High differential pressure test

After each test to determine the ability of a filter element to withstand high differential pressure, the following shall be reported:

- a) name of testing establishment;
- b) filter type (manufacturer, model no. and batch no., as appropriate);
- c) date of test;
- d) test liquid (designation, temperature and viscosity);
- e) results of the fabrication integrity test (ISO 2942);
- f) any permanent distortion of the configuration of the filter medium;

4) Suitable contaminants are Pulverised Vinsol Resin, Carbon and Pulverised Vinsol Resin, or SAE Fine Dust.

- g) any deterioration of the end seals;
- h) any permanent distortion or partial collapse of any other component of the filter element;
- i) any other observations applicable to the particular design of the filter or filter element.

11.2 Elevated temperature test

After each test to determine the ability of a filter element to withstand elevated temperatures, the following shall be reported:

- a) name of testing establishment;
- b) filter type (manufacturer, model no. and batch no., as appropriate);
- c) date of test;
- d) test liquid used for the elevated temperature test (designation and temperature);
- e) test liquid used for the subsequent differential pressure test (designation, temperature, and viscosity);
- f) results of the fabrication integrity test (ISO 2942);
- g) any permanent distortion of the configuration of the filter medium;
- h) any deterioration of the end seals;
- i) any permanent distortion or partial collapse of any other component of the filter element;
- j) any other observations applicable to the particular design of the filter or filter element.

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