INTERNATIONAL STANDARD

ISO 4548-11

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

Part 11:
Self-cleaning filters

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

Partie 11: Filtres à nettoyage automatique

Reference number
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Contents

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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 4548-11 was prepared by Technical Committee ISO/TC 70, *Internal combustion engines*, Subcommittee SC 7, *Tests for lubricating oil filters*.

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*

Annexes A and B of this part of ISO 4548 are 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.

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

Part 11:
Self-cleaning filters

1 Scope

This part of ISO 4548 specifies test methods for evaluating the characteristics of self-cleaning oil filters for internal combustion engines. It is applicable to filters in which self-cleaning is continuous or intermittent.

The removal of retained particles from the filter is achieved by periodic reversal of the direction of the fluid flow through the elements. However, this also applies mechanical stresses to the filter media. The tests specified in this standard are designed to check the filtration performance of the elements under simulated operating conditions and to confirm their ability to withstand, without damage, variations in oil pressure, temperature, direction of flow and the presence of water.

The equipment and procedures specified in this part of ISO 4548 are recommended for filters having a nominal flow rate of up to 1 600 l/min.

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 agreements 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 — Determination of fabrication integrity and determination of the first bubble point.*

ISO 3722:1976, *Hydraulic fluid power — Fluid sample containers — Qualifying and controlling cleaning methods.*

ISO 4405:1991, *Hydraulic fluid power — Fluid contamination — Determination of particulate contamination by the gravimetric method.*

ISO 4548-1:—[1],, *Methods of test for full-flow lubricating oil filters for internal combustion engines — Part 1: Pressure drop/flow characteristics.*

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

1) To be published. (Revision of ISO 4548-1:1982)
2) To be published.

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

ISO 12103-1:— [2], *Road vehicles — Test dust for filter evaluation — Part 1: Arizona test dust.*

3 Definitions

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

3.1 continuous self-cleaning filter
filter in which the process of cleaning the filtering elements operates permanently, irrespective of the operating conditions of the filter and the degree of blockage of the filtering medium

3.2 intermittent self-cleaning filter
filter in which the process of cleaning the filtering elements operates only when one of the characteristic operating parameters of the filter (time, pressure drop) reaches a predetermined value

3.3 retention capacity
mass of specific contaminant that the filtering element can retain at its nominal flow rate before its differential pressure reaches a specified value, such as the value that initiates self-cleaning

3.4 filtration efficiency
ability of the filter to retain particles contained in the fluid to be filtered

3.5 absolute rating
diameter, expressed in micrometres, of the largest non-deformable spherical particle capable of passing through the filtering element under predetermined test conditions

3.6 pressure
gauge pressure

4 Graphical symbols

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

5 Test method for absolute rating (maximum particle diameter transmitted)

5.1 Principle

The test on the filtering element consists of filtering a suspension of calibrated glass microspheres at the nominal flow rate of the filtering element to be tested. A microscopic observation of all the spheres that have passed through the filtering element then allows measurement of the diameter of the largest sphere passing through.

The test gives an indication of the size of the largest pore of the filtering medium employed.

NOTE — The test applies only to the filtering element and not to the complete filter. However a test on the complete filter may be carried out by mutual agreement between the purchaser and the supplier.

5.2 Test equipment and materials

5.2.1 Test fluid

In the absence of any contrary agreement between the supplier and the purchaser of the filter, the oil for the test is to be a pure mineral oil with a kinematic viscosity as ISO VG 15 (see [1]), used at ambient temperature.

2) To be published.

5.2.2 Contaminant

The measurement of the maximum size of particle transmitted shall be carried out with glass microspheres with the particle size distribution given in table 1.

Table 1 — Particle size distribution of glass microspheres

Diameter µm	Mass %
< 20	5 ± 3
⩾ 20 to < 40	10 ± 3
⩾ 40 to < 60	20 ± 3
⩾ 60 to < 100	30 ± 5
⩾ 100 to < 200	35 ± 5

5.2.3 Measuring instruments

The measuring instruments shall be capable of measuring to the levels of accuracy given in table 2.

Table 2 — Accuracy of measuring instruments

Measurement	Accuracy %
Test flow rate	± 5
Relative pressure	± 2
Differential pressure	± 4
Temperature	± 1

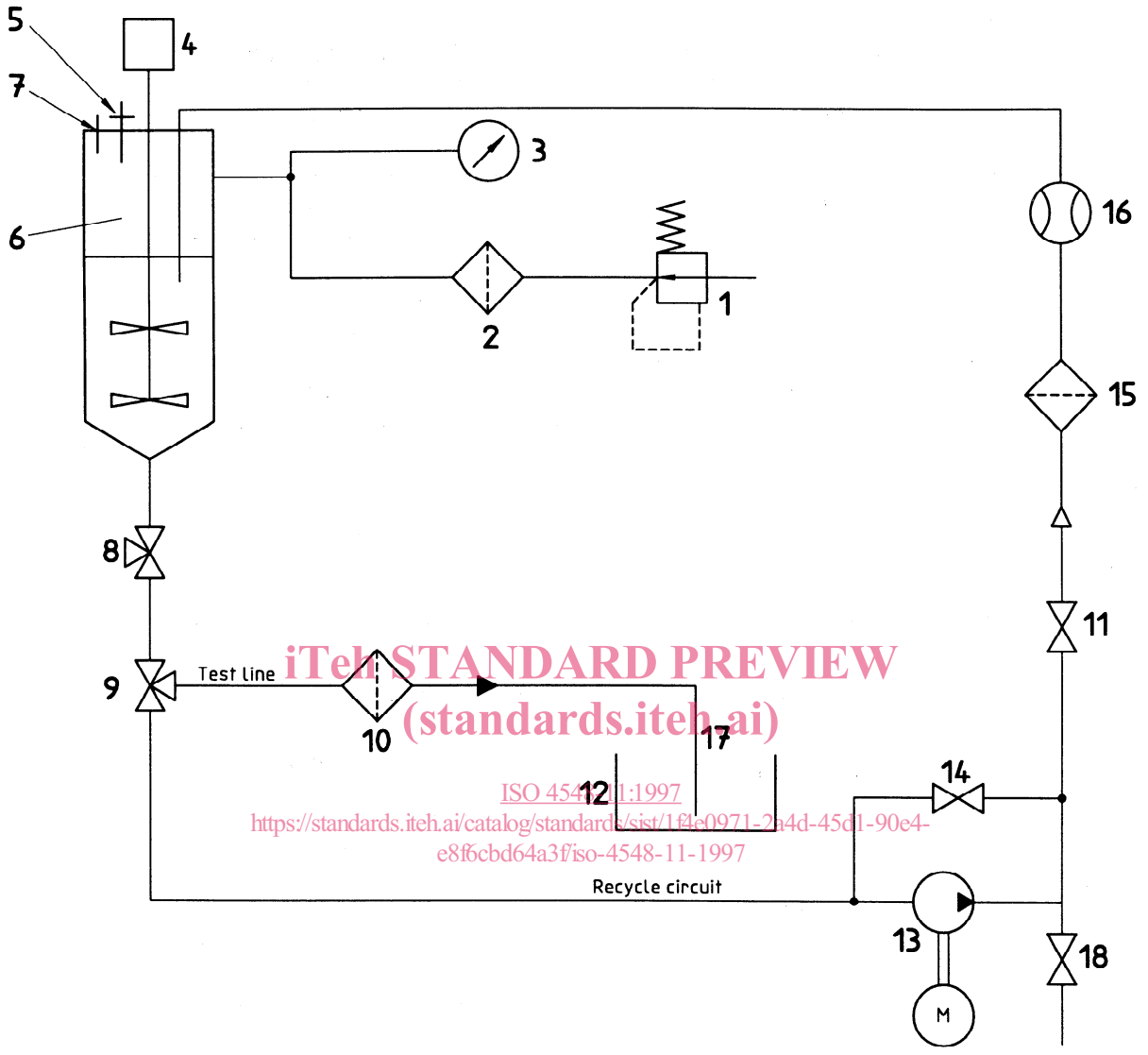
5.2.4 Test rig

The test rig is shown diagramatically in figure 1. It shall include the components described in 5.2.4.1 to 5.2.4.3.

5.2.4.1 Pressure regulator **1**: capable of regulating the pressure maintained in the tank **6** to guarantee a flow of the fluid in the filter under test **10** at its nominal flow rate. Tests shall be conducted to determine the oil flow rate/air pressure curve.

5.2.4.2 Centrifugal pump **13**: capable of providing a turbulent flow of $Re > 3\,000$ in the pipelines.

5.2.4.3 Purification filter **15**: capable of maintaining a level of particulate contamination of the circuit less than or equal to 2 mg/l, in accordance to ISO 4405.



Key

1	Air pressure regulator	10	Test filter
2	Filter (< 0,8 µm)	11	Isolating valve
3	Inlet pressure gauge	12	Sample bottle
4	Agitator (1 500 r/min to 2 000 r/min)	13	Centrifugal pump
5	Relief valve	14	Isolating valve
6	Mixing tank (5 l capacity)	15	Purification filter
7	Contaminant inlet orifice	16	Flow meter
8	Isolating valve	17	New and clean flexible tubing
9	Three-way valve	18	Sampling valve

Figure 1 — Test rig for measurement of maximum particle diameter transmitted

5.3 Test procedure

5.3.1 Preparation of the test rig

5.3.1.1 Fill the mixing tank **6** with 4 l of test fluid and open isolating valves (**8**, **11** and **14**).

5.3.1.2 Set the three-way valve **9** to allow oil to flow through the recycle circuit.

5.3.1.3 Start the pump **13** and slowly close valve **14** causing the fluid to flow through the purification filter for about 30 min.

5.3.1.4 Take a sample of fluid at valve **18** and check that its particulate contamination level is less than or equal to 2 mg/l in accordance with ISO 4405.

5.3.1.5 If the contamination level is not satisfactory, continue purification or install a more efficient purification filter **15**.

5.3.1.6 If the contamination level is satisfactory, stop the pump **13**, close isolating valves (**8**, **11** and **14**) and set the three-way valve **9** to allow the oil to flow to the test line.

5.3.2 Integrity check

Check the integrity of the filtering element in accordance with ISO 2942.

5.3.3 Filter test

NOTE — The test flow rate should not be greater than 20 l/min. If the filtering element to be tested has a designated flow rate less than 20 l/min, it should be tested at that flow rate. If the designated flow rate is greater than 20 l/m, the test should be performed using an element with identical technology and construction, but with reduced height so that the flow velocity of the fluid through the element under test is the same as for the element to be qualified.

5.3.3.1 Mount the filtering element in the filter body, or test housing, of the test filter **10** and install the assembly on the test rig.

5.3.3.2 Start up the agitator **4**.

5.3.3.3 Through orifice **7**, using a clean funnel prepared in accordance with ISO 3722, introduce 0,025 g of contaminant previously mixed in 5 cm^3 of test fluid.

5.3.3.4 Remove the funnel, close the orifice **7** and allow to mix for 3 min.

5.3.3.5 Downstream from the test filter, connect a flexible tube which has never been in contact with the glass spheres.

5.3.3.6 Using the air pressure regulator **1**, pressurize the mixing tank to obtain the designated flow rate through the filtering element.

5.3.3.7 Place a clean sample bottle **12**, which is free of glass spheres, below the flexible tube **17**.

5.3.3.8 Open valve **8**, allow all the test fluid to pass through the filtering element **10** and collect it in the clean sample bottle **12**.

5.3.3.9 Close valve **8** as soon as air appears and close the air pressure regulator **1**.

5.3.3.10 Analyze all the fluid collected as follows:

a) filter on a 5 µm, 47 mm diameter membrane using a vacuum flask;

b) rinse the membrane with a solvent prefiltered at 1 µm;

c) heat the membrane in an oven for 20 min at 80 °C;

d) using a microscope, examine the entire effective area of the membrane, and measure the diameter of the largest spheres observed.

5.4 Test results

The maximum size of particle transmitted through the filtering element is expressed in micrometres and its value is that of the diameter of the largest glass sphere observed on the membrane.

6 Test method for pressure differential/flow characteristics

6.1 Principle

The filter is subjected to increasing and then decreasing values of fluid flow rate to determine the variation in differential pressure as a function of flow rate.

If the temperature of the filtered fluid varies, its viscosity changes. The differential pressure test conducted with a high viscosity fluid serves to simulate the differential pressure that it generates, for example, on cold starting of the engine.

NOTE — The test is performed on a complete filter.

6.2 Test equipment and materials

6.2.1 Test fluid

In the absence of any contrary agreement between the supplier and the purchaser of the filter, the oil used for the test is to be a pure mineral oil with a kinematic viscosity as ISO VG 150.

6.2.2 Measuring instruments

See 5.2.3.

6.2.3 Test rig

The test rig is shown diagramatically in figure 2.

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 10 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. A complete description of the installation is given in ISO 4548-1:—[1], clause 7.

6.3 Test procedure

6.3.1 Preparation of the test rig

Without a test filter mounted in the test rig:

a) set isolating valves **13** to bring the purification filter **12** into the circuit;

b) start up the pump **2** and regulate the flow rate to 1,2 times the flow rate specified by the supplier;

c) allow the fluid to flow for sufficient time to stabilize the temperature at the value specified for the test and provide a contamination level less than 10 mg/l measured in accordance with ISO 4405.