International Standard 4548/2

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Methods of test for full-flow lubricating oil filters for internal combustion engines — Part 2: Element by-pass component characteristics

Méthodes d'essai des filtres à huile de lubrification à passage intégral pour moteurs à combustion interne — Partie 2: Caractéristiques de l'organe de dérivation du filtre

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 4548/2 was developed by Technical Committee ISO/TC 70, *Internal combustion engines*, and was circulated to the member bodies in August 1981.

It has been approved by the member bodies of the following countries:

Australia	Egypt, Arab Rep. of	Romania
Austria	Germany, F.R.	Switzerland
Belgium	Japan	United Kingdom
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The member body of the following country expressed disapproval of the document on technical grounds:

France

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Methods of test for full-flow lubricating oil filters for internal combustion engines — Part 2 : Element by-pass component characteristics

0 Introduction

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

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

1 Scope and field of application

1.1 This part of ISO 4548 specifies tests for determining the element by-pass component characteristics of full-flow lubricating oil filters for internal combustion engines.

1.2 Tests are specified with oils at two viscosities, one to assess the performance of an element by-pass component with a cold oil and the other to assess its performance with an oil at a typical operating temperature.

2 References

ISO 1219, *Fluid power systems and components — Graphic symbols.*

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

3 Definitions and symbols

3.1 Definitions

For the purpose of this part of ISO 4548, the definitions given in part 1 of the standard apply.

3.2 Symbols

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

4 Operational characteristics to be tested

4.1 The purpose of the element by-pass component of a lubricating oil filter is to maintain an adequate supply of oil to the engine when the pressure drop across the filter element is high, even if the oil is not then filtered. Such conditions may occur, for example, when the engine is started from cold or in the event of the element becoming choked.

4.2 To limit the quantity of unfiltered oil passed to the engine when there is no excessive pressure drop across the filter, it is customary for the by-pass component to be designed not to open below a specified pressure drop and to allow leakage at no more than a specified rate when the pressure drop is not above the value.

4.3 To maintain an adequate oil supply to the engine when the filter element is completely choked, it is customary for the by-pass component to be designed to pass the full oil flow with no more than a specified pressure drop. The tests specified in this part 2 of the standard measure the pressure drop across the by-pass component over the whole range of oil flow rates.

4.4 The tests include the requirement that a note shall be made of any noise emitted by the by-pass component for example, due to valve oscillation. This is because there has been found to be a correlation between noise in these components and wear.

4.5 The pressure drop is measured across the complete filter assembly as in 5.5.

5 Test rig

5.1 The test rig is shown diagrammatically in the figure. It shall include the following components, together with the necessary tubing, connectors and supports.

Item no. (see figure)	Description
(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 pressure drop across the filter by-pass component.
(10)	Valve in the filter outlet pipe to divert the flow into a measuring cylinder.
(11)	Throttle valve (for flow regulation)
(12)	Differential pressure gauge or two single pressure gauges to measure the pressure drop across the filter by-pass component if required.
(13)	Free discharge pipe

5.2 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 within a limit of ± 5 %.

5.3 The regulating valves ((3) and (11) in the figure) shall be used for the purpose of pressure and flow control. Needle valves or diaphragm type valves are recommended.

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

5.5 The filter element shall be removed from the filter and in its place there shall be installed a non-permeable dummy element of identical dimensions. In the case of a filter whose element cannot readily be replaced by a non-permeable dummy element, for example a spin-on cartridge filter, the unit shall be opened and the by-pass component shall be removed for testing in a separate housing, the design of which shall be agreed between the manufacturer and the purchaser of the filter.

5.6 The inlet pipe to the filter, or the inlet pipe to the separate housing containing the element by-pass component, shall be straight for approximately 6 pipe internal diameters d, and the same shall apply to the outlet pipe. Over these same distances the inlet and outlet pipes shall have bores 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 with which the filter is to be used. Tappings for the measurements of the pressure drop across the filter shall be made at approximately 3 pipe internal diameters before the inlet port and at approximately 5 pipe internal diameters after the outlet port.

5.7 The filter by-pass component for test, the test liquid and the test rig shall be clean. In this part of ISO 4548, the term "clean" means that there is no detectable increase in pressure drop across a filter of the type under test (not modified in accordance with 5.5) when the test liquid at the test temperature is circulated through the test rig and the filter at the filter rated flow for 5 min.

5.8 Pressures shall be measured to an accuracy of ± 5 % and be recorded in bars.[1)]

5.9 To avoid draining the complete filter outlet pipe when the leakage rate is being measured, the free discharge pipe from the sampling valve ((10) in the figure) shall be taken to a height level with the filter under test (the discharge pipe is not shown in the figure).

6 Test liquids

Unless otherwise agreed between the manufacturer and the purchaser of a filter, lubricating oils shall be selected and used in the tests with kinematic viscosities of 24 mm^2/s (cSt) at approximately 75 °C for simulating general operating conditions and of 500 mm^2/s (cSt) at approximately 42 °C when simulating cold conditions of operation. The temperature of the oils during the test shall not exceed 100 °C.

In order to achieve these viscosities at these approximate temperatures it will be necessary to use two different oils.

The test liquid must be clean (see 5.7).

NOTE — 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 partial or complete replacement of the test oils.

1) 1 bar = 100 kPa

7 Test procedure

7.1 Install the filter under test, modified in accordance with 5.5, in the test rig as shown in the figure.

7.2 Add sufficient clean test liquid to the sump (1) in the figure) and circulate it through the test rig via the by-pass pipe only. No test liquid shall pass through the filter at this stage.

7.3 Switch on the heater or cooler and adjust the thermostat to the required temperature (see clause 6). Allow the temperature to become stabilized.

7.4 When the temperature of the oil in the sump (1) in the figure) has become stabilized, pass the test liquid through the filter by-pass component at approximately 50 % of the filter rated flow. Allow the temperature to become stabilized again. Bleed the system if necessary.

7.5 When the temperature indicator (7) in the figure) shows that the temperature of the oil at the filter inlet has become stabilized at the required value (see clause 6), prime the free discharge pipe from the sampling valve (10) in the figure), the oil collected from it being returned to the sump. Reduce the flow through the filter by-pass component to zero several times.

7.6 Slowly increase the inlet pressure to the element by-pass component to a value 10 % below the specified minimum permissible opening pressure of the component. Measure any leakage that occurs at this pressure drop by collecting in a graduated cylinder the outflow from the sampling valve (10) in the figure), the time taken to collect the sample being measured by a stop watch. Before collecting the sample, ensure that the leakage flow has stabilized.

7.7 Take measurements of the pressure drop across the element by-pass component at each of at least eight flow rates at approximately equal increments up to 110 % the filter rated flow noting the opening pressure of the by-pass component. Obtain the required flow by adjustment of the pressure and flow regulating valves (3) and (11) in the figure), ensuring that the inlet pressure exceeds the indicated pressure drop so that a positive pressure is maintained at the filter outlet. Each required value of flow rate shall be approached from a lower value. Hold the flow constant for a period of not less than 10 s or until pressure readings have stabilized before taking each reading of pressure drop.

7.8 Decrease the flow and take measurements of the pressure drop across the element by-pass component at the same rates of flow as were used in 7.7, and using the procedure detailed in 7.7 except that each required value of flow rate shall be approached from a higher value. Note the closing pressure of the by-pass component.

7.9 When the pressure drop has been decreased to a value 10 % below the specified minimum opening pressure of the element by-pass component, measure any leakage at this pressure drop in accordance with 7.6.

7.10 If noise is emitted by the element by-pass component during the test, note the rates of flow at which it occurs and the characteristic of the noise.

7.11 Carry out the procedure described in 7.2 to 7.10 for each viscosity oil.

8 Report of test results

8.1 For each viscosity, the pressure drop across the element by-pass component shall be shown graphically with respect to increasing and decreasing flow rates [see 8.2 j)]. Flow rates at which noise is emitted shall be marked along the contour of the curves.

8.2 The leakage rates at the specified minimum permissible opening pressure of the element by-pass component shall be reported for increasing and decreasing pressure drops.

8.3 A typical report is given as follows :

Report on element by-pass component tests

a) Testing establishment

b) Filter type (manufacturer, model no. ..... and batch no. ..... as appropriate);

c) Date of test

d) Test liquid (designation) ..... at ..... °C (..... cSt)
Test liquid (designation) ..... at ..... °C (..... cSt)

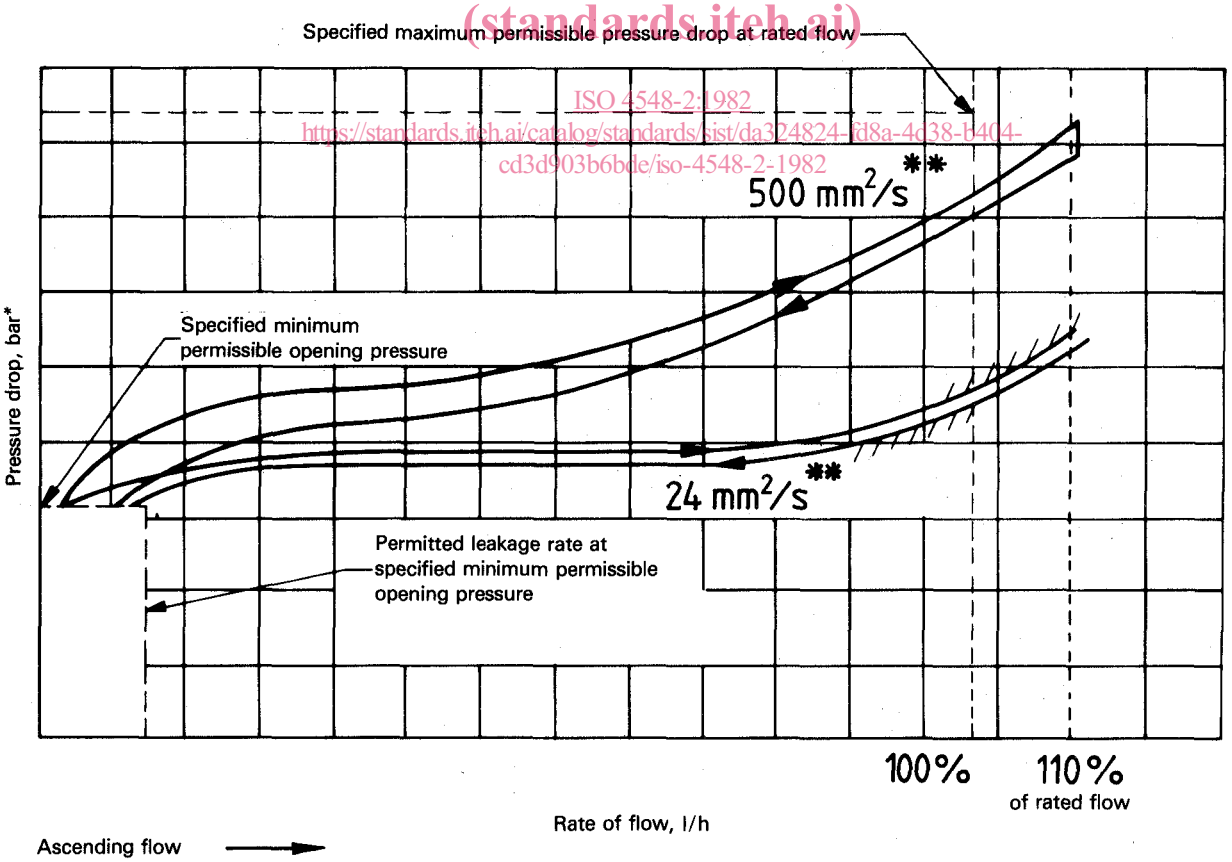
e) Specified minimum opening pressure of by-pass component

f) Leakage rate at this pressure drop 24 mm^2/s (cSt) 500 mm^2/s (cSt)
with increasing pressure .....
with decreasing pressure .....

g) Pressure drop at rated flow
with increasing pressure .....
with decreasing pressure .....

h) Provide a simple sketch of the by-pass component test assembly and the position of the pressure tappings.

j) Graph of variations.



Ascending flow →

Descending flow ←

Noise emission ⌇⌇⌇⌇⌇

* 1 bar = 100 kPa

** 1 mm^2/s = 1 cSt

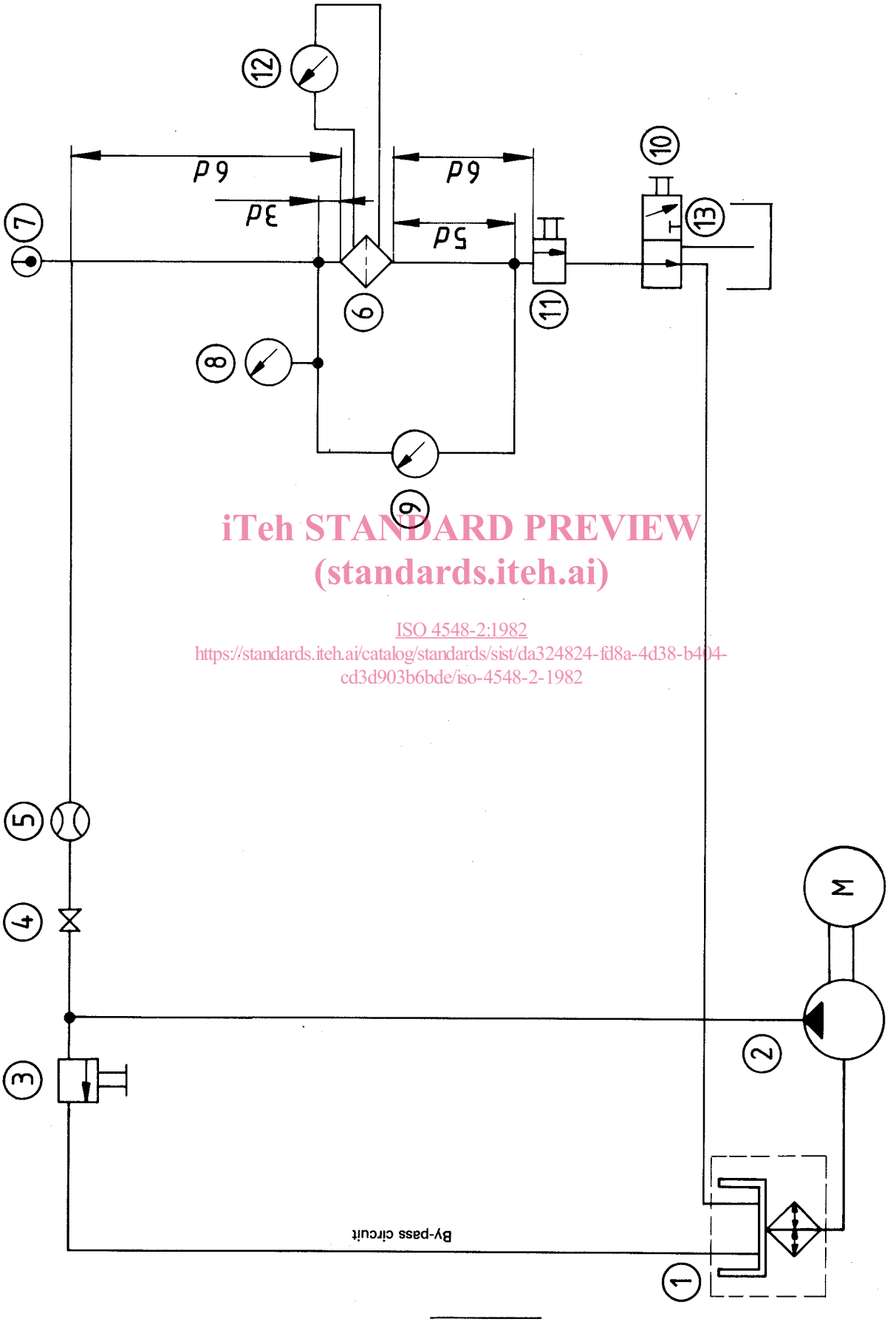


Figure — Diagrammatic arrangement of test rig

Specified pipe lengths are expressed in terms of the internal diameter of the pipe (d)