International Standard 4548/1

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

Méthodes d'essai des filtres à huile de lubrification à passage intégral pour moteurs à combustion interne — Partie 1: Caractéristique débit/perte de charge

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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 4548/1 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	Netherlands
Austria	Germany, F.R.	Romania
Belgium	Italy	Switzerland
Brazil	Japan	United Kingdom
Bulgaria	Korea, Rep. of	USA
Czechoslovakia	Korea, Dem. P. Rep. of	USSR

The member body of the following country expressed disapproval of the document on technical grounds:

France

Printed in Switzerland

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

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 pressure drop/flow 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 a filter 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 6415, *Spin-on filters for lubricating oil — Dimensions.*

3 Definitions and symbols

3.1 Definitions

For the purposes of this International Standard the following definitions apply.

3.1.1 filter : Device that, as liquid passes through, separates insoluble contaminants by retaining them on or in a porous medium or on or in an assembly of porous and/or fibrous layers.

NOTE — There are other devices that perform the same function as a filter but not by retaining the contaminant in the manner described above; they should be designated, not as filters, but as cleaners, precipitators, separators, etc.

3.1.2 lubricating oil filter : Filter in which the liquid filtered is lubricating oil.

3.1.3 full-flow lubricating oil filter : Lubricating oil filter through which is passed the whole of the quantity of lubricant delivered to the lubrication system.

3.1.4 filter assembly : Assembly consisting of the filter casing, the inlet and outlet ports and the filter element; it may also include such other components as the filter element by-pass component and the anti-drain valve, if they are specified.

3.1.5 spin-on cartridge filter : Lubricating oil filter, consisting of a replaceable assembly with an integral filter element, that is screwed directly into or onto an engine lubricating system; the assembly may include the filter element by-pass component and the anti-drain valve, if they are specified.

3.1.6 filter element : Component of a filter whose purpose is to retain the insoluble contaminant.

3.1.7 filter element by-pass component : Component in a filter that permits unfiltered oil to by-pass the filter element when a preset differential pressure is reached.

3.1.8 by-pass component opening pressure : Opening pressure across the by-pass component which results in a specified flow rate.

3.1.9 by-pass component closing pressure : Closing pressure across the by-pass component which results in a specified flow rate.

3.1.10 anti-drain valve : Component in a filter that prevents oil draining from the filter casing when the engine is not in operation.

3.1.11 pressure drop : Difference in pressure at any given time between two specified points in a system through which oil is flowing.

3.1.12 rated flow : Nominal value specified by the manufacturer at specified conditions of viscosity and pressure drop.

3.2 Symbols

The symbols used in this International Standard are in accordance with ISO 1219.

4 Operational characteristics to be tested

4.1 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.

4.2 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 pressure drop. The tests specified in this part of ISO 4548 measure the pressure drop across a complete filter assembly, in a clean condition, over the whole range of oil flow rates.

4.3 The pressure drop 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 valve, if one is fitted, as well as to the pressure drop across the filter element itself. For some purposes it is necessary to know the pressure drop across the filter element 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 in 4.2, the tests specified measure the pressure drop across a clean filter element over the whole range of oil flow rates.

5 Test rig

5.1 The test rig is shown diagrammatically in figure 1. It shall include the following components, together with the necessary tubing, connectors and supports :

Item no. (see figure 1)	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
(10)	Differential pressure gauge or two single pressure gauges to measure the pressure drop across the filter element
(11)	Throttle valve (for flow regulation)

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 figure 1) shall be used for the purposes 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 For the purpose of mounting the filter under test in the test rig, the following types of filter are recognized :

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

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

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

5.6 In the case of the types of filter indicated in 5.5 a), a special test head will be required, and a typical example is shown in figure 2. The pressure drop across the complete filter assembly shall be measured using the pressure tappings marked A and B with C removed. The pressure drop 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.

5.7 In the case of the types of filter indicated in 5.5 b) and c), the inlet pipe to the filter 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 size 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 measurement of the pressure drop across the complete 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.

5.8 In the case of the types of filter indicated in 5.5 b) and c), tappings for the measurement of the pressure drop 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 pressure drop across the filter element; a typical housing is shown in figure 3.

5.9 The filter element for the test shall be unused and the test liquid and the test rig shall be clean. In this part, the term "clean" means that there is no detectable increase in pressure drop 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 filter rated flow for 5 min.

5.10 Pressure differences shall be measured to an accuracy of ± 5 % and be recorded in bars[1].

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) for simulating general operating conditions and of 500 mm^2/s (cSt) when simulating cold conditions of operation both at the temperature of the test. The temperature of the oils during the test shall not exceed 100 °C.

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

The test liquid must be clean (see 5.9).

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.

7 Test procedure

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

7.2 Add the required quantity of clean test liquid to the sump (① in figure 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.

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 figure 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.

7.5 When the temperature indicator (⑦ in figure 1) shows that the temperature of the oil at the filter inlet has become stabilized at the required value (see clause 6), take measurements of the pressure drop 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 in figure 1), ensuring that the inlet pressure exceeds the indicated pressure drop 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 pressure drop.

7.6 Carry out the procedure described in 7.3 to 7.6 for each viscosity oil.

7.7 If the pressure drop across the filter element is required, a separate test shall be conducted in accordance with 5.6 or 5.8 using the test procedures described in clause 7.

1) 1 bar = 100 kPa.

8 Report of test results

8.1 For each viscosity, the pressure drop across the complete filter and the pressure drop across the filter element shall be shown graphically with respect to flow rate [(see 8.2 e)].

8.2 A typical report is given as follows :

Report of filter pressure drop/flow test

a) Testing establishment

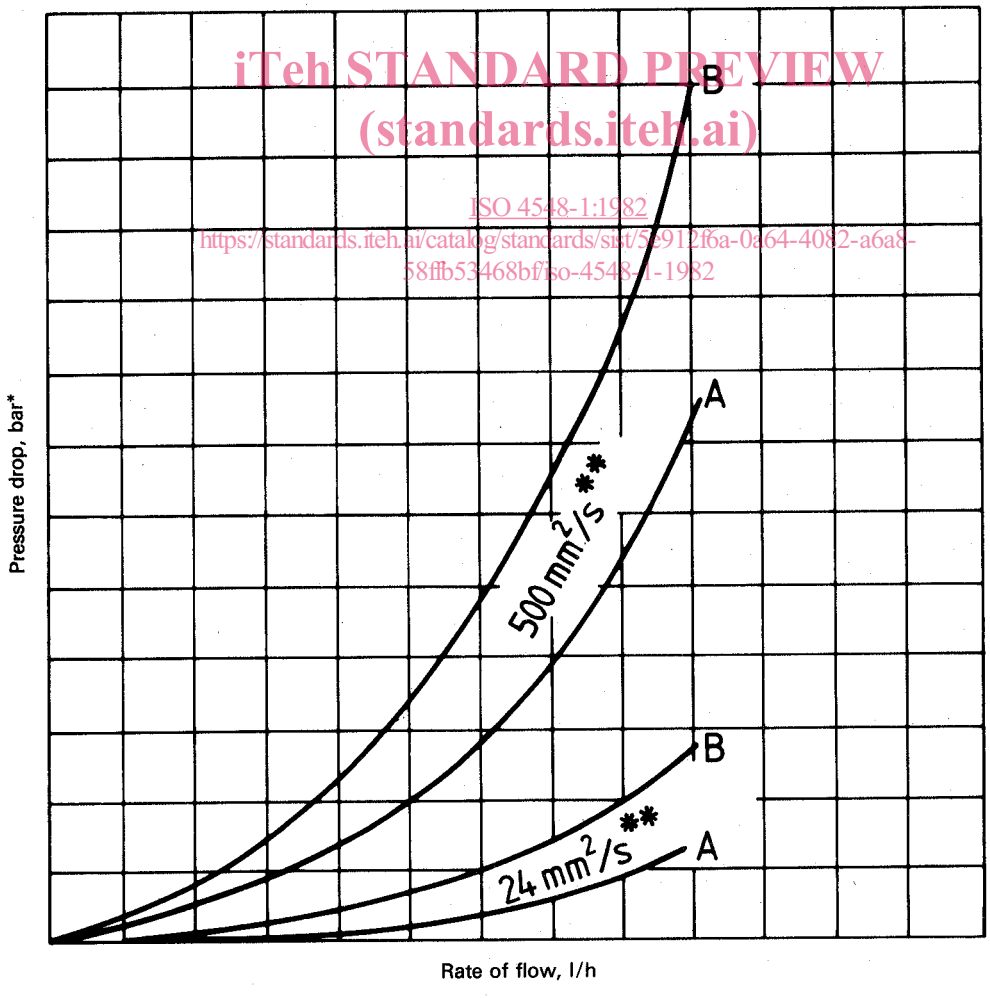
b) Filter type (manufacturer, model no. .....and batch no., ...as appropriate)

c) Date of tests

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

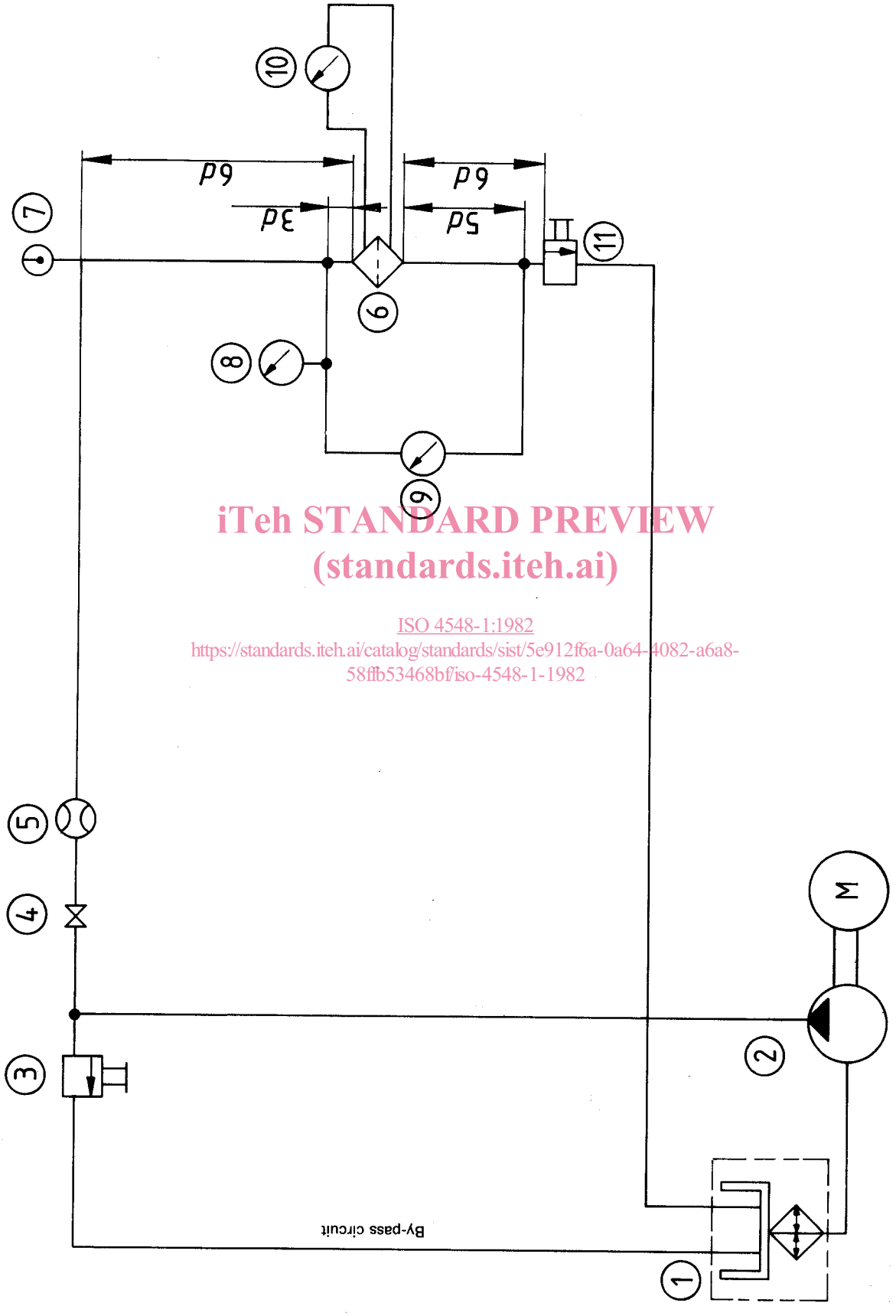
Test liquid [500 mm^2/s (cSt)] .....(designation) at .....°C

e) Graph of variations



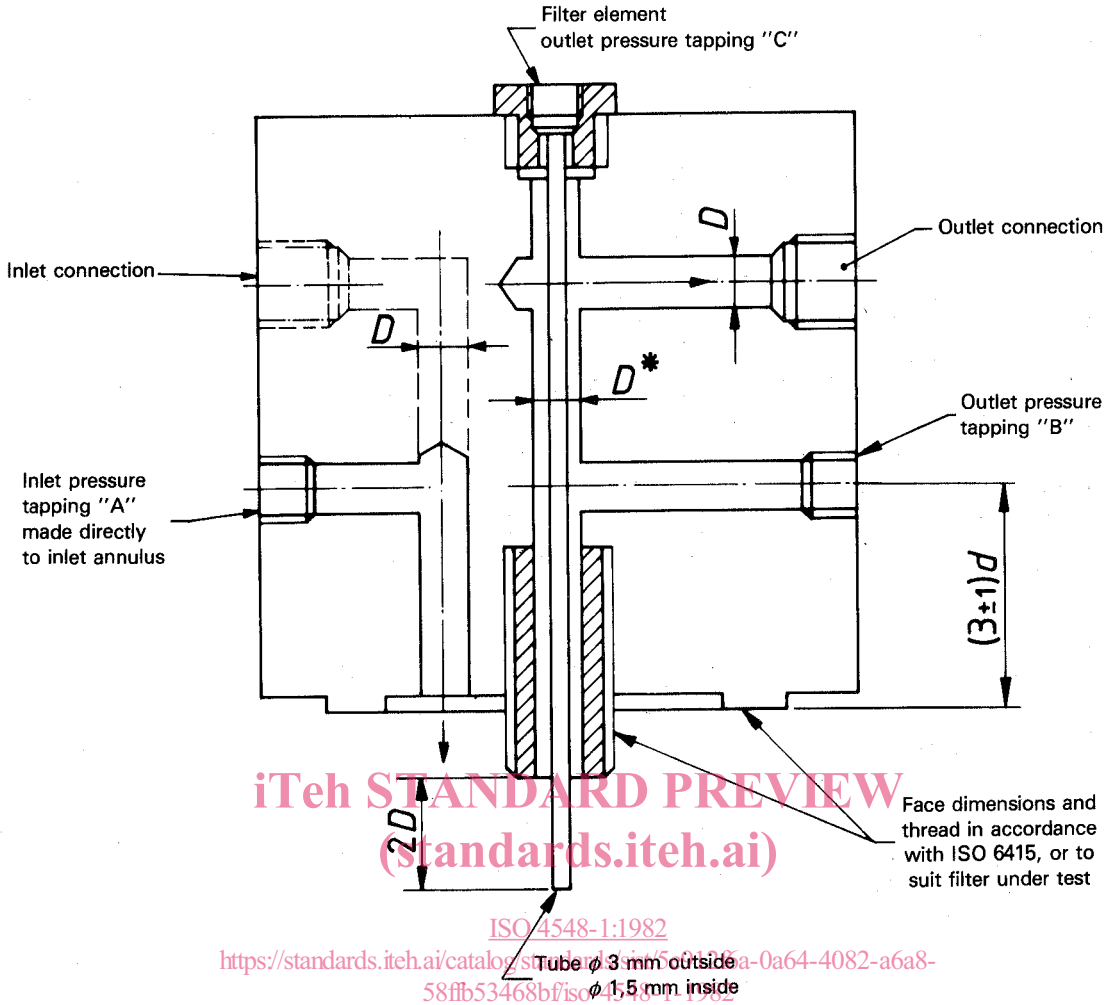
A Filter element
B Complete filter

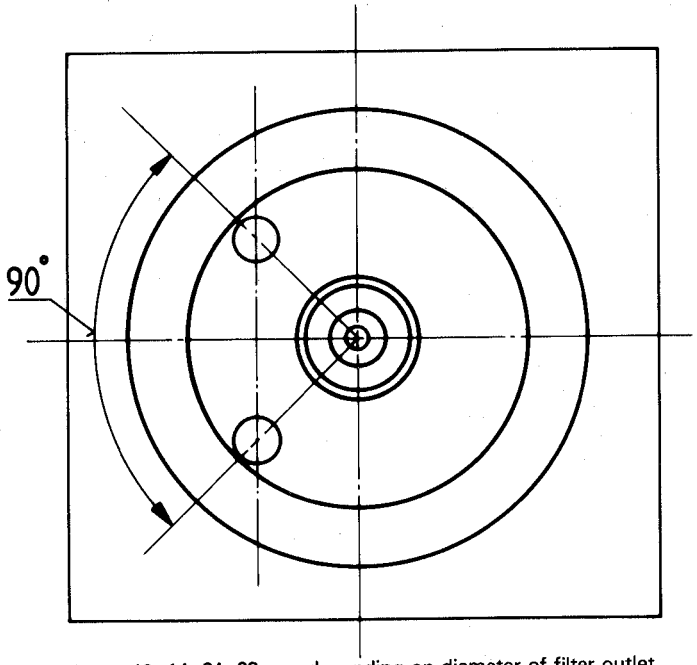
*1 bar = 100 kPa
**1 mm^2/s = 1 cSt



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

Figure 1 — Diagrammatic arrangement of test rig





*D = 10, 14, 24, 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 cast head

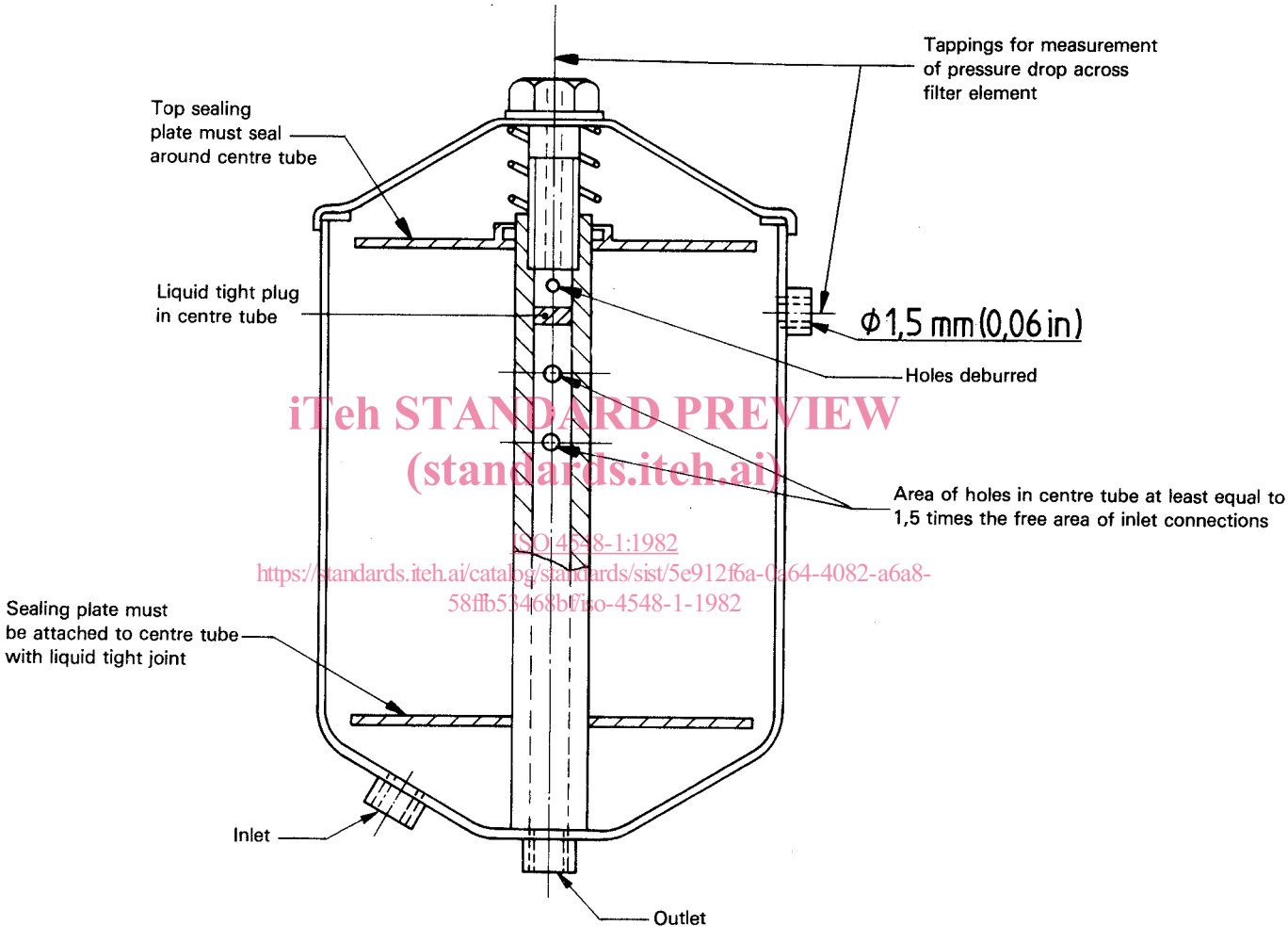


Figure 3 — Typical test housing