

Method of test for

Petrol filters

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Committees responsible for this British Standard

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Foreword

This British Standard has been prepared by Subcommittee MCE/21/6.

The methods described in this standard do not cover all the desired fields and further methods may be added to future revisions of this standard.

Appropriate precautions are necessary to ensure the safety of personnel carrying out the tests in this standard.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 24, an inside back cover and a back cover.

Method

1 Scope

This British Standard describes methods for determination of flow rate versus pressure drop, single pass efficiency and micrometre rating, and rig life, cumulative efficiency and dust holding capacity of petrol filters intended for automotive and marine internal combustion engines.

2 Normative references

This British Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on the inside back cover. For dated references, only the edition cited applies; any subsequent amendments to or revisions of the cited publications apply to this British Standard only when incorporated in the reference by amendment or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

3 Test to determine flow rate versus pressure drop

3.1 Principle

Liquid is passed through a filter at various flow rates and the resistance of the filter at each flow rate is measured.

3.2 Test liquid

The test liquid shall be a straight mineral oil with properties as given in annex A.

3.3 Apparatus

3.3.1 *Test rig assembly*, comprising components **3.3.2** to **3.3.8**.

NOTE. A diagram of the test rig assembly is shown in figure 1.

3.3.2 *Reservoir*, of 5 l minimum capacity.

3.3.3 *Electric diaphragm pump*, of 6 l/min maximum flow and of 35 m maximum head.

3.3.4 *Flow control valve*.

3.3.5 *Differential pressure gauge*, capable of reading in excess of 70 kPa.

3.3.6 *Thermometer*.

3.3.7 *Flow meter*.

3.3.8 *Piping*, of inside diameter (i.d.) 6 mm smooth bore tube provided with an upstream pressure tapping 50 mm from the test filter inlet and a downstream pressure tapping 80 mm from the test filter outlet.

3.4 Mounting of test filters

3.4.1 Mount axial flow filters vertically with the outlet uppermost.

3.4.2 Mount other types of filter as appropriate to their manner of operation.

3.5 Procedure

NOTE. The numbers that appear in brackets in this clause relate to the numbers in figure 1.

3.5.1 Place 5 l of clean test liquid into the test rig reservoir (1), install a 'clean up' filter, similar to the filter to be tested, in the test filter position (4), start the pump (2) and circulate the test liquid through the 'clean up' filter for 15 min.

3.5.2 Remove the 'clean up' filter and replace with the test filter, ensuring that air is removed from the test filter prior to starting the test.

3.5.3 Circulate the test liquid through the test filter and note the pressure differential Δp at 50 %, 75 %, 100 % and 125 % of the rated flow of the filter.

3.6 Expression of results

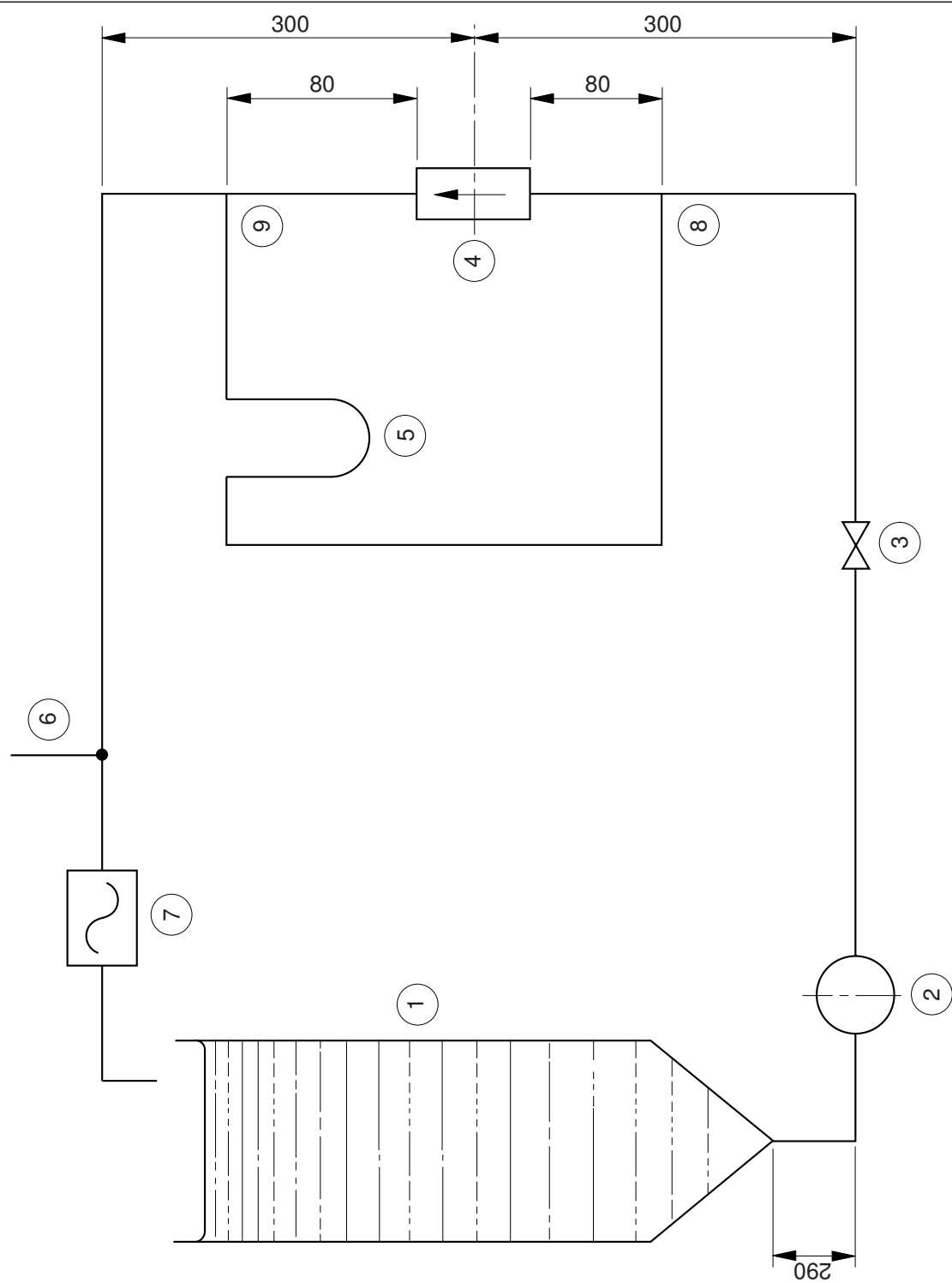
Plot a graph of differential pressure Δp versus flow rate.

3.7 Test report

The test report shall include at least the following information:

- a) the name of the organization conducting the test;
- b) the date of the test;
- c) the make and model number of the filter;
- d) a description of the filter;
- e) the rated flow of the filter;
- f) the test flow rates and the corresponding differential pressures;
- g) the type of test liquid;
- h) the test temperature.

NOTE. The graph (see **3.6**) should also be included if required by the purchaser.



- Key:**
- | | |
|--------------------------------|---------------------------|
| 1. Reservoir | 6 Thermometer |
| 2. Electric diaphragm pump | 7 Flow meter |
| 3. Flow control valve | 8 Inlet pressure tapping |
| 4. Filter under test | 9 Outlet pressure tapping |
| 5. Differential pressure gauge | |

Dimensions in millimetres

Figure 1. Test rig for determination of flow rate versus pressure drop

4 Test to determine single pass efficiency and micrometre rating

NOTE. Two test procedures are described as follows.

- 1) Test procedure A: Analysis of samples by HIAC particle counter¹⁾, using SAE test dust²⁾;
- 2) Test procedure B: Analysis of samples gravimetrically and by ashing, using MIRA test dusts²⁾.

Both procedures are suitable for obtaining a filter micrometre rating result. Procedure A is the preferred procedure and this procedure should be used wherever possible.

4.1 Principle

Particles of known sizes are offered to a filter and the efficiency of their removal is measured.

4.2 Materials

4.2.1 Test liquid, a straight mineral oil with properties as given in annex A.

4.2.2 Test dusts

- a) For procedure A: SAE fine test dust²⁾.
- b) For procedure B: MIRA test dusts M1, M2, M3²⁾.

NOTE 1. MIRA M4 test dust may be required for testing very coarse filters.

NOTE 2. Specifications for the test dusts are given in annex B.

4.2.3 Dispersant, oil-based, ashless.

4.2.4 Membrane filter discs, of diameter 140 mm, and 0.8 μm mean pore size.

4.2.5 Petroleum distillate, (required for procedure B only), analytical grade, filtered through a 0.45 μm pore size membrane.

4.2.6 Distilled water.

4.3 Apparatus

4.3.1 Test rig assembly, comprising components **4.3.2** to **4.3.10**.

NOTE. A diagram of the test rig assembly is shown in figure 2.

4.3.2 Funnel.

4.3.3 Stirrer, rated at approximately 1000 r/min.

4.3.4 Spherical separating flask, of 2 l capacity.

4.3.5 Stopcock.

4.3.6 Influent sampling point pinchcock.

4.3.7 Flow control cock.

4.3.8 Isolating cock.

4.3.9 Effluent sampling point pinchcock.

4.3.10 Tubing, of i.d. 5.5 mm glass with clear PVC tubing used for joining sections, where required.

4.3.11 Membrane filter disc holder, as shown in figure 3.

4.3.12 Vacuum flask and pump, as shown in figure 4.

4.3.13 Hot air oven, capable of maintaining a temperature of $140^\circ\text{C} \pm 20^\circ\text{C}$.

4.3.14 Desiccator.

4.3.15 Analytical balance, having ± 0.1 mg readability.

4.3.16 Stop watch.

4.3.17 Measuring cylinder, of 500 ml capacity.

4.3.18 Beaker, of 800 ml capacity.

4.3.19 HIAC particle size analyser (required for procedure A only, complete with high concentration sensor and calibration chart).

4.3.20 Magnetic stirrer and follower (required for procedure A only).

4.3.21 Sample bottles (required for procedure A only), of 120 ml capacity to suit HIAC particle size analyser.

4.3.22 Wash bottle (required for procedure A only), of 250 ml capacity for test liquid.

4.3.23 Muffle furnace (required for procedure B only) capable of maintaining a minimum temperature of $800^\circ\text{C} \pm 50^\circ\text{C}$.

4.3.24 Seven crucibles (required for procedure B only), of 40 mm diameter $\times$ 30 mm depth with lids.

4.3.25 Tongs (required for procedure B only), with extended handles for use in muffle furnace.

4.3.26 Beaker (required for procedure B only), of 2 l capacity.

4.3.27 Beaker (required for procedure B only), of 250 ml capacity.

4.3.28 Coarse/fast filter discs (required for procedure B only).

4.3.29 Wash bottle (required for procedure B only), of 200 ml capacity for petroleum distillate.

4.4 Preparation of test contaminant suspensions for use in procedures A and B

4.4.1 Place sufficient test dust or powder in a hot air oven at $140^\circ\text{C} \pm 20^\circ\text{C}$ for 2 h, then allow it to cool and store it in a desiccator.

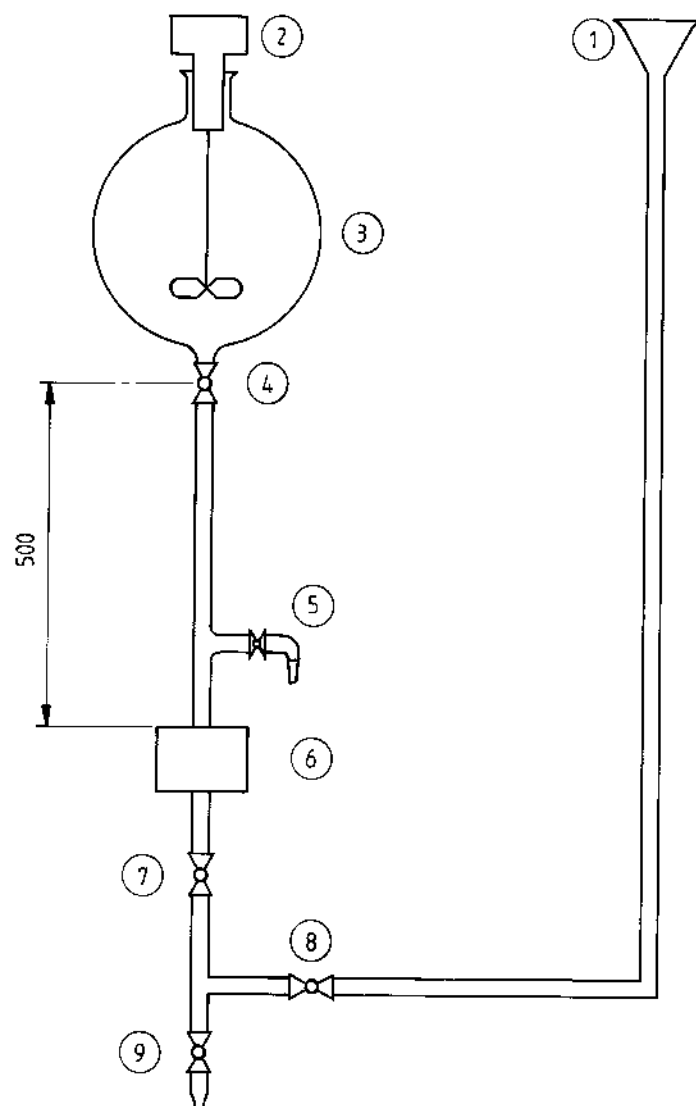
4.4.2 Filter approximately 2 l of test liquid through a membrane filter disc (see figures 3 and 4).

4.4.3 Weigh out, using an analytical balance, between 25 mg and 30 mg of test material, record its exact weight, and mix with approximately 100 mg of dispersant on the watch glass. Wash it into an 800 ml beaker with a small quantity taken from 500 ml of pre-filtered test liquid.

4.4.4 Add the remainder of the pre-filtered test liquid to the test dust and stir at approximately 1000 r/min for 15 min.

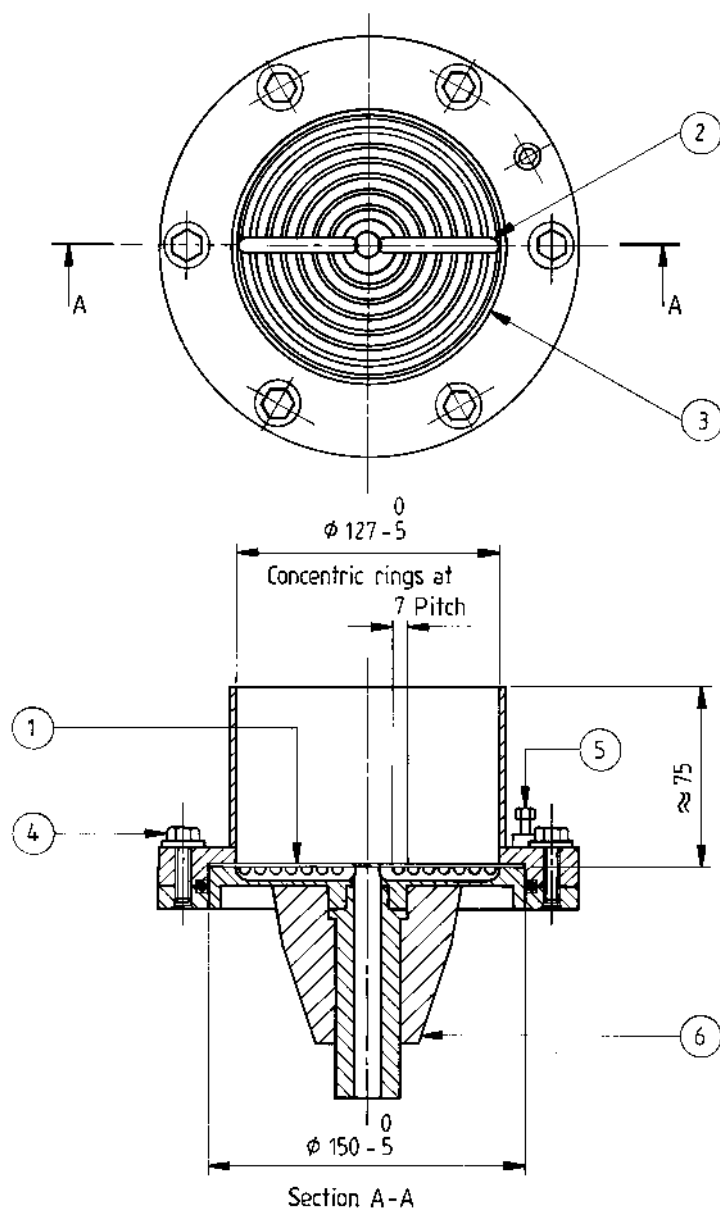
¹⁾ For this standard the HIAC particle counter (Pacific Scientific Ltd., 11801 Tech Road, Maryland 20904-1909, USA) was used. Other instruments employing the light extinction principle described in BS 3406 : Part 7 may be used, but the results may not correlate with those of this standard.

²⁾ For information on the availability of SAE (Society of Automotive Engineers) and MIRA (Motor Industry Research Association) test dusts, contact the BSI library, BSI Head Office, 389 Chiswick High Road, London W4 4AL.

**Key**

1. Funnel
2. Stirrer
3. Spherical separating flask (2 l)
4. Stopcock
5. Influent sampling point pinchcock
6. Test filter
7. Flow control cock
8. Isolating cock
9. Effluent sampling point pinchcock

Figure 2. Test rig for determination of single pass efficiency and micrometre rating



Key

1. Position of filter disc
2. Drainage channel
3. Concentric rings
4. Six clamp bolts
5. Static earth point
6. Bung to suit flask

Figure 3. Typical 140 mm diameter filter disc holder assembly