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

Part 7:  
**Vibration fatigue test**

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

*Partie 7: Essai de fatigue aux vibrations*





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Published in Switzerland

# Contents

	Page
Foreword .....	iv
<b>1 Scope .....</b>	<b>1</b>
<b>2 Normative reference .....</b>	<b>1</b>
<b>3 Terms, definitions and graphical symbols .....</b>	<b>1</b>
3.1 Definitions .....	1
3.2 Graphical symbols .....	1
<b>4 Principle .....</b>	<b>1</b>
<b>5 Test rig .....</b>	<b>1</b>
<b>6 Test liquid .....</b>	<b>2</b>
<b>7 Vibration fatigue test .....</b>	<b>2</b>
<b>8 Test report .....</b>	<b>4</b>
<b>Bibliography .....</b>	<b>6</b>

## 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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 4548-7 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 4548-7:1990), 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: Method of test for cold start simulation and hydraulic pulse durability*
- *Part 6: Static burst pressure test*
- *Part 7: Vibration fatigue test*
- *Part 9: Inlet and outlet anti-drain valve tests*
- *Part 11: Self-cleaning filters*
- *Part 12: Filtration efficiency using particle counting, and contaminant retention capacity*
- *Part 13: Static burst pressure test for composite pressure vessel materials*
- *Part 15: Vibration fatigue test with composite materials*

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

## Part 7: Vibration fatigue test

### 1 Scope

This part of ISO 4548 specifies a method of testing the constructional integrity of full-flow lubricating oil filters to withstand engine vibrations. This test is intended for application to spin-on type filters and detachable filters with disposable elements with a maximum flow rate of 100 l/min.

This test method is intended for test parts made from materials that do not experience mechanical property changes within the temperature range experienced in service. The test may be applied to other filters if thought applicable by agreement between the filter manufacturer and the purchaser.

### 2 Normative reference

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

### 3 Terms, definitions and graphical symbols

#### 3.1 Definitions

For the purposes of this document, the terms and definitions given in ISO 4548-1 apply.

#### 3.2 Graphical symbols

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

### 4 Principle

Integrally mounted oil filter assemblies, including filter heads, adaptors, mounting brackets, etc., are subjected to forcing frequencies due to engine or installation vibrations. The test method specified in this part of ISO 4548 verifies the ability of the filter assembly to withstand these vibrations for a predetermined number of cycles, while under pressure.

### 5 Test rig

The test rig shall comprise the following components, together with the necessary tubing, connectors and supports (see Figure 1):

- a) electro-mechanical vibrator, together with the necessary hardware and electronics to control and monitor displacement, velocity and acceleration;

- b) oil pressure source, which may be manually or mechanically operated;
- c) device to measure oil pressure, with sufficient range to cover the rated pressure of the test filter;
- d) two accelerometers, featuring linear calibration and ranges appropriate for the part being tested;
- e) filter to be tested, together with filter head or adaptor.

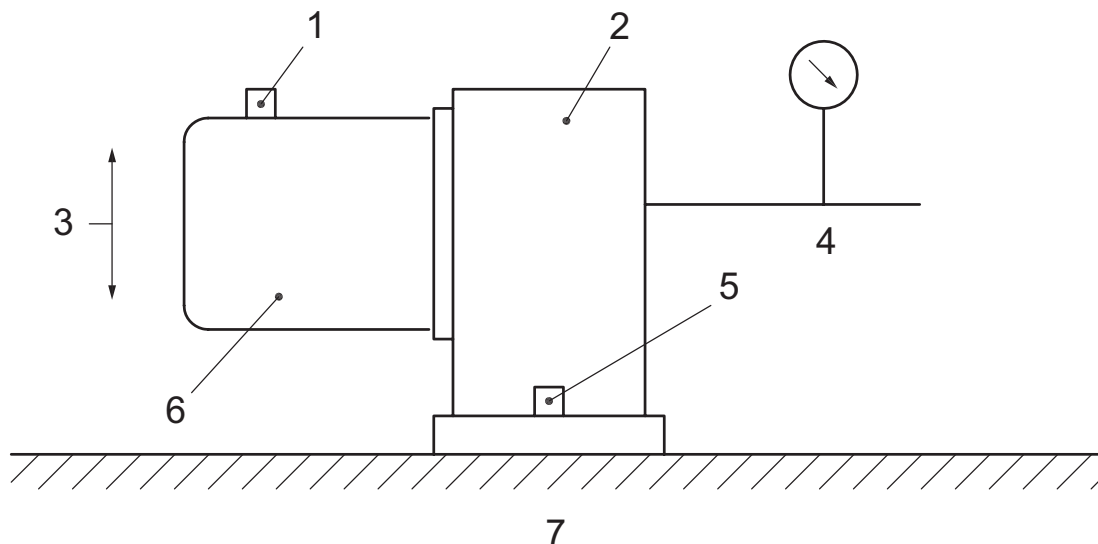


Figure 1 — Test rig: first arrangement

**Key**

- 1 Output accelerometer
- 2 Filter head or adaptor
- 3 Axis of excitation
- 4 Pressure source
- 5 Input accelerometer
- 6 Oil filter under test
- 7 Vibrator table

**6 Test liquid**

The test liquid shall be oil with a kinematic viscosity of less than  $10 \text{ mm}^2/\text{s} \pm 5 \text{ mm}^2/\text{s}$  at ambient temperature [ISO viscosity class ISO VG22 at 63 °C or SAE 5W at 68 °C (see [2] and [3])].

**7 Vibration fatigue test**

**7.1** Install the filter on the filter head or adaptor, applying the recommended torque or angle of rotation for the filter to be tested.

**7.2** Mount the filter and head assembly on a rigid bracket or adaptor plate with high deformation resistance, using suitable jointing or sealant to ensure leak-proof mating surfaces.

**7.3** Rigidly mount the bracket or adaptor plate/filter assembly on the vibrator table, ensuring that the filter polar axis is at right angles to the axis of excitation (see Figure 1).

**7.4** Connect the filter to a pressure gauge and to a source of oil pressure at normal ambient temperature, using flexible tubing in such a way as to ensure that it does not interfere with the vibration of the filter unit.

**7.5** Attach the input accelerometer to the filter head/adaptor and the output accelerometer to the filter, positioned approximately 100 mm from the top face of the sealing ring, or at a distance equivalent to 0,85 of the filter length if the filter is shorter than 120 mm. The polar axis of both accelerometers shall be parallel to the axis of excitation (see Figure 1). Make the appropriate electrical connections between the accelerometer, vibration control and monitoring equipment.

**7.6** Ensure that the test filter is filled with the test liquid and that all entrapped air has been expelled from the assembly. Pressurize the assembly to the rated pressure of the filter, or as agreed upon by the manufacturer and customer. If no test pressure is given, then pressurize the test filter 500 kPa. This pressure should be maintained throughout the duration of the test.

**7.7** Start the vibrator and conduct a resonant search up to a frequency of 400 Hz, maintaining peak input acceleration at a constant value of  $60 \pm 0.3 \text{ m/s}^2$ , unless otherwise agreed upon by the filter manufacturer and customer.

Use the following criteria to determine the frequency at which to perform the fatigue test in 7.8. If resonance occurs at a single frequency, then carry out the test at that frequency. If resonance occurs at more than one frequency, carry out the test at the frequency which exhibits the maximum amplitude (peak-to-peak displacement). If resonance does not occur, carry out the test at a frequency of 150 Hz.

Adjust the power of the vibrator to give peak input acceleration as agreed between the filter manufacturer and engine manufacturer or, in the absence of such an agreement, an acceleration of  $60 \text{ m/s}^2$ , and determine the total amplitude of vibration.

NOTE The total amplitude (peak-to-peak) of vibration,  $S$ , in metres, can be calculated as follows:

$$S = \frac{a}{2\pi^2 f^2}$$

where

$a$  is the peak acceleration, in metres per second squared;

$f$  is the frequency of vibration, in Hertz.

**7.8** Test the assembly to a total of  $10^7$  cycles unless prior failure occurs. Commence testing at the frequency determined in 7.7. Since the resonant frequency of the assembly under test could vary throughout the test, verify the test filter resonance periodically. This can be done automatically by shaker controllers with resonance tracking. Otherwise, repeat the procedure described in 7.7 and correct the frequency values after each  $5 \times 10^5$  cycles and continue with the test.

**7.9** If  $10^7$  cycles can be completed without apparent failure, then repeat the procedures given in 7.1 to 7.8 but with the test filter oriented such that the polar axis is normal to the axis of excitation. Position the accelerometers as shown in Figure 2.

**7.10** If  $10^7$  cycles in the second direction can be completed without apparent failure, determine the removal torque or angle of rotation of the test filter for comparison with the initial setting.

**7.11** Drain the test of fluid and carefully dismantle it to reveal any visual signs of internal damage.

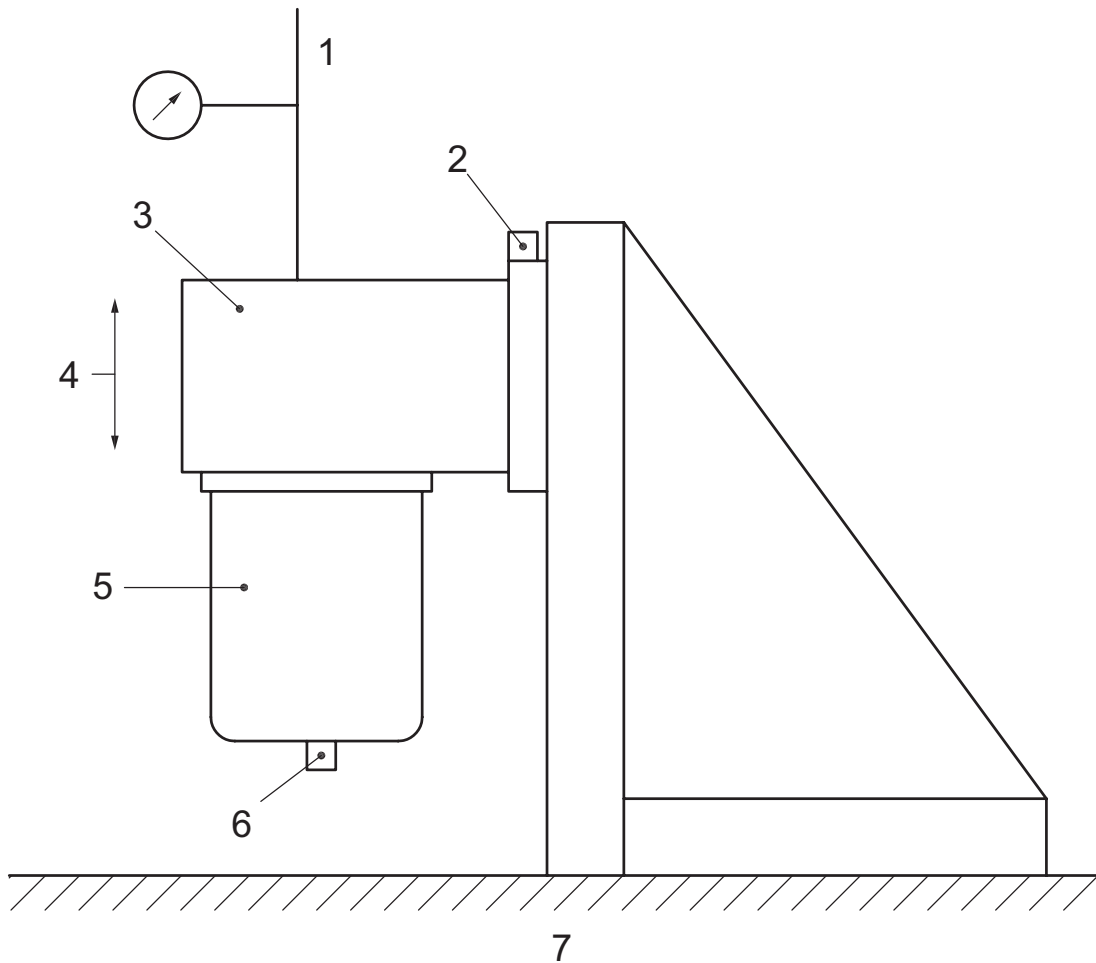


Figure 2 — Test rig: second arrangement

**Key**

- 1 Pressure source
- 2 Input accelerometer
- 3 Adaptor
- 4 Axis of excitation
- 5 Oil Filter under test
- 6 Output accelerometer
- 7 Vibrator table

**8 Test report**

The test report shall include at least the following:

- a) the name of the test establishment;
- b) the filter type (manufacturer, model number, and batch number);
- c) the date of the test;
- d) a description of the filter and whether it is new or used; if it is used, the approximate period of service;
- e) the rated flow, in litres per minute;



- f) the test pressure, in kPa;
- g) the amplitude and frequency of vibration;
- h) the mode of failure and its location;
- i) the number of cycles to failure or number of cycles completed;
- j) the torque applied initially to install spin-on filter and at the end of the test to remove the filter (in Newton metres).

## Bibliography

- [1] ISO 1219 (all parts), *Fluid power systems and components — Graphic symbols and circuit diagrams*
- [2] ISO 3448, *Industrial liquid lubricants — ISO viscosity classification*
- [3] SAE J300c, *Engine oil viscosity classification*



