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Petroleum products — Determination of the filterability of lubricating oils —

Part 1: Procedure for oils in the presence of water

Produits pétroliers — Détermination de la filtrabilité des huiles lubrifiantes —

Partie 1: Méthode pour les huiles en présence d'eau

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 28, *Petroleum and related products, fuels and lubricants from natural or synthetic sources*.

This third edition cancels and replaces the second edition (ISO 13357-1:2017), which has been technically revised.

The main changes are as follows:

— included the use of gravimetric measurement techniques;

— included the use of alternative membranes when testing higher viscosity oils.

A list of all parts in the ISO 13357 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

To minimize wear on the components of an oil-lubricated system, it is important to reduce the concentrations of circulating hard contaminant particles. This is particularly important for hydraulic power systems, for systems whose performance and reliability rely on the maintenance of small clearances and orifices, or for systems that include rolling element bearings as components. These contaminants are removed by the use of filters. The ability of an oil to pass through fine filters, without plugging them, is called its filterability. This document describes a laboratory test procedure for assessing the filterability of mineral oils which have been subjected to prolonged hot contact with water. Filterability so determined is not a physical characteristic of the oil, but represents an estimation of its behaviour in service.

This document describes two measurements, referred to as “stages”. The stage I determination is based on a comparison of the mean flow rate of a fluid through a test membrane with its initial flow rate. Oils having good stage I filterability, but a poor stage II performance (see below), are not likely to have performance problems in use, unless extremely fine system filters are utilized.

The stage II determination is based upon the ratio between the initial flow rate of the fluid through the test membrane and the rate at the end of the test. This part of the procedure is a more severe test and is more sensitive to the presence of gels and fine silts in the oil. Silts and gels can be present in an oil when it is produced or can be formed as an oil ages, especially when hot. An oil with good stage II filterability is unlikely to have filtration problems even in extreme conditions and with fine (less than 5 µm) filtration present. It is thus suitable for use in more critical hydraulic and lubrication systems.

This procedure was developed primarily for hydraulic oils having ISO viscosity grades up to 100, and, apart from the filtration apparatus, was designed to be implemented using mainly standard laboratory apparatus. A modified procedure that includes gravimetric measurements rather than volumetric ones is provided in Annex B. Further, the method has been adapted to test oils of higher viscosity grade than 100 using a coarser membrane filter.

This document defines a method for assessing the filterability of oils in the presence of contaminating water. Some oils will exhibit poorer filterability characteristics in these conditions. ISO 13357-2 is used to investigate the filterability of an oil which is used in applications where the presence of water in the oil is unlikely. An oil which has good filterability in the presence of contaminating water does not necessarily have equally good filterability in dry conditions. An oil having good filterability only when wet is not likely to be generally acceptable.

Petroleum products — Determination of the filterability of lubricating oils —

Part 1:
Procedure for oils in the presence of water

WARNING — The use of this document can involve hazardous materials, operations and equipment. This document does not purport to address all of the safety problems associated with its use. It is the responsibility of users of this document to take appropriate measures to ensure the safety and health of personnel prior to application of the document, and fulfil statutory and regulatory requirements for this purpose.

1 Scope

This document specifies a procedure for the evaluation of the filterability of lubricating oils in the presence of water. The procedure only applies to mineral-based oils, since fluids manufactured from other materials (e.g. fire-resistant fluids) can be incompatible with the specified test membranes. This document is applicable to oils of viscosity up to ISO viscosity grade (VG) 100, as defined in ISO 3448. Within the range described, the variation in filterability due to viscosity is included within the precision range of this document. The procedure is not suitable for some hydraulic oils on which specific properties are conferred by the use of insoluble or partially soluble additives, or by particularly large molecular species. These additives include some viscosity index modifiers and some friction modifying additives.

This document can also be applied to oils of ISO viscosity grades (VG) 150, 220 and 320, as defined in ISO 3448, using the specified 3,0 µm rated membranes. These oils are widely used as heavy-duty lubricants in equipment such as paper making machines and rolling mills. Within the range described, the filterability as defined is not dependent on the viscosity of the oil.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 3170, *Petroleum liquids — Manual sampling*

ISO 3448, *Industrial liquid lubricants — ISO viscosity classification*

ISO 3696, *Water for analytical laboratory use — Specification and test methods*

ISO 4788, *Laboratory glassware — Graduated measuring cylinders*

ISO 6614:1994, *Petroleum products — Determination of water separability of petroleum oils and synthetic fluids*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
filterability
ratio, expressed as a percentage, between volumes (stage I) or flow rates (stage II) at specified intervals in the test procedure

3.2
stage I filterability
ratio, expressed as a percentage, between 240 ml and the volume of oil actually filtered in the time that 240 ml would have theoretically taken, assuming no plugging of the membrane

3.3
stage II filterability
ratio, expressed as a percentage, between the flow rate near the start of the filtration and the flow rate between 200 ml and 300 ml of filtered volume

4 Principle

The test fluid is treated with water at an elevated temperature, filtered under specified conditions through a membrane of specified mean pore diameter, and the times for the specified filtrate volumes are recorded. Filterabilities are calculated from ratios of the filtration rate near the start of filtration to the filtration rate at specified higher filtered volumes. The result of the test is the average of the three determined values.

NOTE In the ideal situation, the filtration rate remains constant.

5 Reagents and materials

5.1 Water, conforming to grade 3 of ISO 3696.

5.2 Propan-2-ol (isopropyl alcohol), filtered through a compatible 0,45 µm membrane filter (see 6.14).

5.3 Wash solvent, of light aliphatic hydrocarbon, filtered through a compatible 0,45 µm membrane filter (see 6.14). Heptane or 2,2,4-trimethylpentane is suitable.

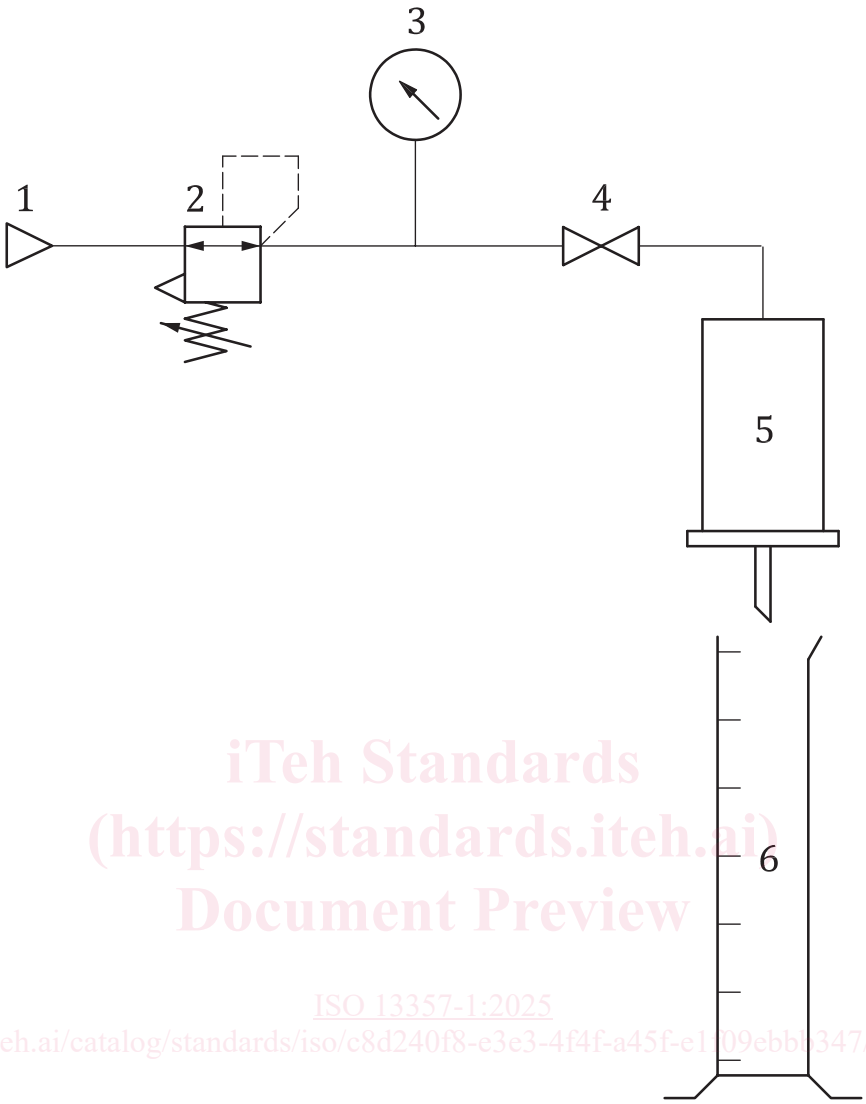
5.4 Compressed gas, complete with a regulator system capable of supplying gas at nominated pressures between 50 kPa and 200 kPa. The gas (air or nitrogen) shall be dry and filtered.

6 Apparatus

6.1 If carrying out the test using gravimetric techniques, refer to the apparatus list in B.1.

6.2 Filtration apparatus, constructed of stainless steel, consisting of a lidded funnel of at least 350 ml capacity, and a funnel base with filter support, such that a membrane filter (6.3) can be clamped between the sealing surfaces of the funnel and the base by means of a metal clamp or other suitable gas-tight closure. The apparatus shall be grounded (earthed); and suitable electrical bonding of the parts shall be provided.

The effective filtration area shall be 1 130 mm^2 ± 60 mm^2. A schematic of the assembled apparatus, with the graphical symbols conforming to ISO 1219-1, is shown in Figure 1.



Key

1	source of compressed air or nitrogen	4	ball valve
2	pressure regulator	5	pressure vessel with membrane support
3	pressure gauge	6	measuring cylinder

Figure 1 — Outline of assembled filtration apparatus

6.3 Membrane filters, of mixed cellulose esters and with a diameter of 47 mm. For oils with ISO viscosity grades ≤ 100, use membranes with a mean pore size of 0,8 µm; for oils with ISO viscosity grades > 100, use membranes with a mean pore size of 3,0 µm.

All the membranes used for a single test (3 determinations) should be taken from a single box. If membranes are taken from more than one box, all boxes shall be from the same production batch.

NOTE Millipore membranes of an equivalent specification to their filter membranes, catalogue number AAWP04700,[1)] have been found satisfactory for oils with ISO viscosity grades ≤ 100; membranes of an equivalent specification to their filter membranes, catalogue number SSWP04700,[1)] have been found satisfactory for oils with ISO viscosity grades > 100.

6.4 Measuring cylinder, of borosilicate glass and with a 250 ml capacity, conforming to the requirements of ISO 4788. This cylinder shall be permanently marked with further graduation marks at 10 ml and 300 ml. Annex A describes a procedure for adding these graduations.

The cylinder should be wrapped with a grounded (earthed) metal helix or mesh which does not obscure the graduations, particularly with oils having very low electrical conductivity (e.g. ashless oils).

NOTE The 250 ml measuring cylinder has a total capacity in excess of 300 ml, allowing the extra graduations to be added. The use of a larger measuring cylinder for the filtration process would not give adequate precision for the test. This measuring cylinder is not required if measurements are to be carried out gravimetrically (see Annex B).

6.5 Measuring cylinder, of borosilicate glass, capable of measuring 330 ml ± 10 ml.

6.6 Pressure gauge, dial or digital type, capable of reading the required delivery pressures (see 9.12) ±5 kPa.

6.7 Forceps, spade-ended.

6.8 Timing device, electronic or mechanical, capable of reading to the nearest 0,2 s, and fitted with a dual-stop facility.

6.9 Oven, controlled at 70 °C ± 2 °C.

6.10 Petri dishes, loosely covered.

6.11 Bottles, of 500 ml laboratory type with screw caps. The exact shape of the bottle is unimportant; and 500 ml conical flasks can be used. However, the neck should be narrow, but shall be wide enough to accept the stirrer (6.12). The base of the bottle should be flat.

6.12 Motor and stirrer, conforming to the requirements of ISO 6614:1994, 6.3.

6.13 Pipettes.

6.13.1 Pasteur or dropping pipette.

6.13.2 1 ml graduated pipette.

6.14 Pressurized solvent dispenser, fitted with a membrane holder containing a compatible 0,45 µm membrane filter immediately upstream of the nozzle. Two are required, one for the propan-2-ol (5.2) and one for the wash solvent (5.3).

1) Millipore membranes, catalogue numbers AAWP04700 and SSWP04700 are examples of a suitable products available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.