INTERNATIONAL STANDARD

ISO 13357-2

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Petroleum products — Determination of the filterability of lubricating oils —

Part 2:
Procedure for dry oils

Produits pétroliers — Détermination de la filtrabilité des huiles lubrifiantes — Partie 2: Méthode pour les huiles non polluées par de l'eau

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.

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.

International Standard ISO 13357-2 was prepared by Technical Committee ISO/TC 28, *Petroleum products and lubricants*.

ISO 13357 consists of the following parts, under the general title *Petroleum products — Determination of the filterability of lubricating oils*:

— *Part 1: Procedure for oils containing water*

— *Part 2: Procedure for dry oils*

Annex A of this part of ISO 13357 is for information only.

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Introduction

The fluid in a hydraulic system acts as a lubricant, and to minimize wear of the components, it is important to reduce the concentrations of circulating hard contaminant particles. This is particularly necessary when the performance of the system depends on the maintenance of small clearances and orifices. Removal of these contaminants is effected by the use of filters, and the ability of a hydraulic fluid to pass through fine filters, without plugging them, is called its filterability. This part of ISO 13357 describes a laboratory test procedure for assessing the filterability of mineral oils in a dry state. Filterability so determined is not a physical characteristic of the oil, but represents an estimation of its behaviour in service.

This part of ISO 13357 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 only a poor Stage II performance (see below), would be unlikely to give performance problems in use, unless extremely fine system filters are utilized.

The Stage II determination is based on the ratio between the initial flow rate of fluid through the test membrane and the rate at the end of the test. It is considered that 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 may be present in an oil when it is produced, or could be formed as an oil ages, especially when hot. An oil with good Stage II filterability would be unlikely to give filtration problems even in the most extreme conditions, and with fine (less than 5 μm) filtration present. It would thus be suitable for use in more critical hydraulic and lubrication systems.

The procedure has been evaluated with mineral oils up to ISO viscosity grade 100. There would appear to be no practical reason why it should not be used with oils of higher viscosity grades, but the data obtained could not be claimed to be completely in accordance with this method. Similarly, it should be possible to extend the test procedure to fluids other than mineral oils. However, some fluids, e.g. fire-resistant fluids, will not be compatible with the specified test membranes, and the test could only be used for comparison purposes even when suitable membranes, with similar pore size/pore density characteristics to those specified in this procedure, have been identified.

Petroleum products — Determination of the filterability of lubricating oils —

Part 2:
Procedure for dry oils

WARNING – The use of this part of ISO 13357 may involve hazardous materials, operations and equipment. This part of ISO 13357 does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this part of ISO 13357 to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1 Scope

This part of ISO 13357 specifies a procedure for the evaluation of the filterability of dry lubricating oils, particularly those designed for hydraulic applications. The procedure only applies to mineral-based oils, since fluids manufactured from other materials (e.g. fire-resistant fluids) may not be compatible with the specified test membranes. The range of application has been evaluated with oils of viscosity up to ISO viscosity grade (VG) 100, as defined in ISO 3448. Within the range described, the filterability as defined is not dependent on the viscosity of the oil. The procedure is not suitable for some hydraulic oils on which specific properties have been conferred by the use of insoluble/partially soluble additives, or by particularly large molecular species.

NOTE — Filterability is a prime requirement for lubricating oils used in hydraulic systems because of the fine filters used in this application.

This part of ISO 13357 defines a method for assessing the filterability of dry oils. It should be noted that some oils will exhibit degraded filterability characteristics in the presence of contaminating water. ISO 13357-1 should be used to investigate the effect of water and high temperature on filterability, if an oil is to be used in applications where the presence of water in the oil is likely.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 13357. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 13357 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3170:1988, *Petroleum liquids – Manual sampling.*

ISO 3448:1992, *Industrial liquid lubricants – ISO viscosity classification.*

ISO 3696:1987, *Water for analytical laboratory use – Specification and test methods.*

ISO 4259:1992, *Petroleum products – Determination and application of precision data in relation to methods of test.*

ISO 4788:1980, *Laboratory glassware – Graduated measuring cylinders.*

ISO 13357-1:—[1)], *Petroleum products – Determination of the filterability of lubricating oils – Part 1: Procedure for oils containing water.*

1) To be published.

3 Principle

The test fluid is filtered under specified conditions through a membrane of 0,8 µm mean pore diameter, and the time for a nominated series of volume filtrations is 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 three determined values.

NOTE — Ideally, the filtration rate should remain constant.

4 Definitions

For the purposes of this part of ISO 13357, the following definitions apply.

4.1 filterability: Dimensionless number, expressed as a percentage, which is the relationship between two filtration rates.

4.2 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.

4.3 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.

5 Reagents and materials

5.1 Water, conforming to grade 3 of ISO 3696.

5.2 Propan-2-ol, filtered through a compatible 0,45 µm membrane filter.

NOTE — A solvent-filtering dispenser, as shown in figure 1, is a means of dispensing this solvent, and the wash solvent (5.3)

5.3 Wash solvent, of light aliphatic hydrocarbon, filtered through a compatible 0,45 µm membrane filter (see note in 5.2). Heptane, 2,2,4-trimethylpentane or light petroleum spirits are suitable.

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

6 Apparatus

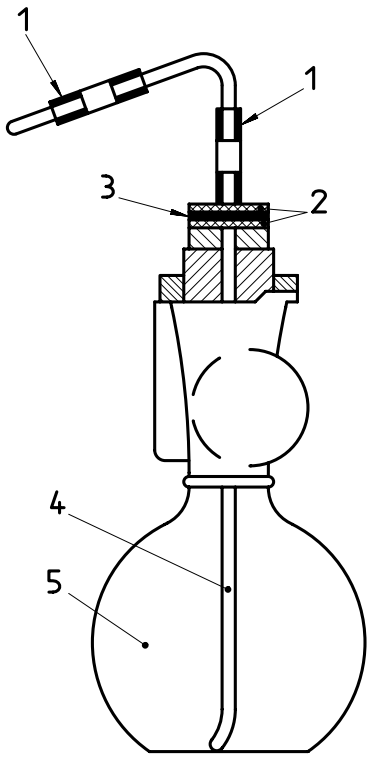
A schematic of the assembled apparatus is shown in figure 2.

6.1 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 (6.2) 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 $mm^2 \pm 60$ mm^2.

6.2 Membrane filters, of mixed cellulose esters, diameter 47 mm and mean pore size of 0,8 µm.

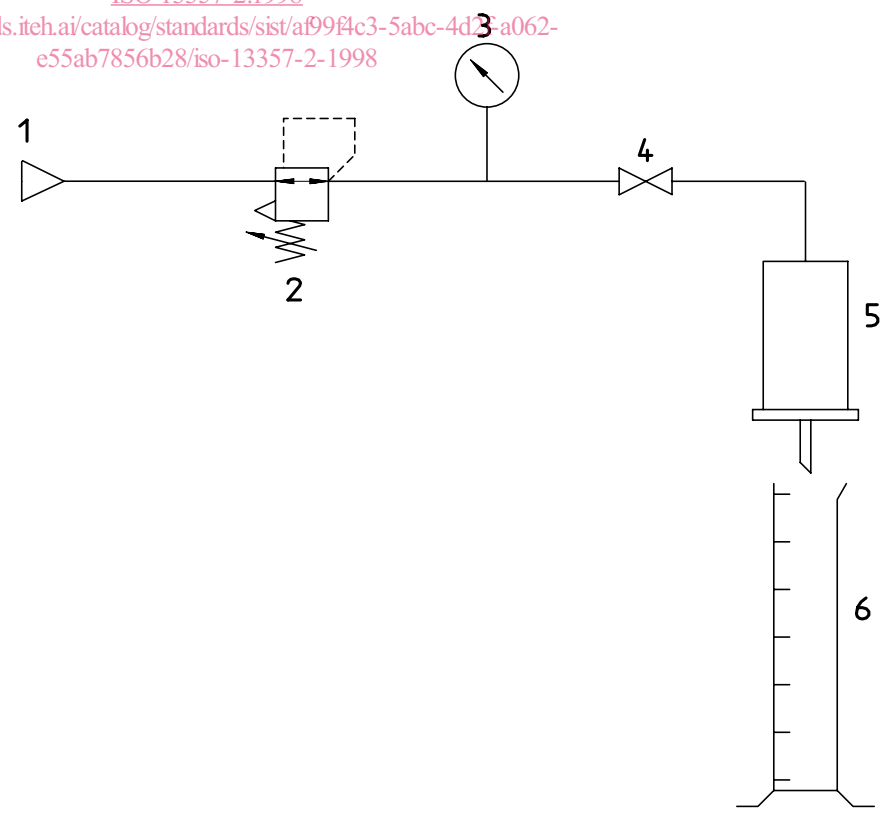
NOTE — Membranes of an equivalent specification to Millipore filter membranes, catalogue number AAWP 047 IF, have been found satisfactory.

6.3 Measuring cylinders, one of borosilicate glass, of 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. A second cylinder, capable of measuring 320 ml ± 5 ml is also required.



Key
1 Reagent-resistant plastic tubing
2 Inert support screen
3 Membrane filter, 0,45 µm
4 Reagent-resistant plastic tubing
5 Solvent-filtering dispenser

Figure 1 — Solvent-filtering dispenser



Key
1 Source of compressed air or nitrogen
2 Pressure regulator
3 Pressure gauge
4 Ball valve
5 Pressure vessel with membrane support
6 Measuring cylinder

Figure 2 — Outline of assembled filtration apparatus

6.4 Pressure gauge, dial or digital type, capable of reading the required delivery pressures (see 9.4) ± 5 kPa.

6.5 Forceps, spade-ended.

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

6.7 Oven, controlled at 70 °C ± 10 °C.

6.8 Petri dishes, loosely covered.

7 Samples and sampling

7.1 Unless otherwise specified, samples shall be taken by the procedure specified in ISO 3170.

7.2 Shake the laboratory sample thoroughly by hand, and allow it to stand for 24 h at a temperature of 15 °C to 25 °C.

NOTE — The optimum ambient laboratory temperature for precision is 22 °C.

8 Preparation of apparatus

Rinse the apparatus with wash solvent (5.3) to remove traces of oil from previous tests.

Soak in laboratory detergent solution overnight, or scrub thoroughly with hot laboratory detergent solution.

Rinse with hot tap water, followed by cold tap water.

Rinse with water (5.1).

Rinse with propan-2-ol (5.2).

Rinse with wash solvent (5.3) and allow to dry.

9 Procedure

A diagram of a typical determination is shown as figure 3.

9.1 Carry out the test in triplicate.

9.2 Place a membrane filter (6.2) in a loosely covered Petri dish (6.8) in the oven (6.7) for 10 min. Handle the membrane filter by the edge only, using forceps (6.5), during this and all subsequent operations.

9.3 Assemble the filtration apparatus (6.1) with a membrane filter the correct way up (see note below), in place. Ensure that the apparatus is properly grounded (earthed), there are no leaks in the pressure system, and that the measuring cylinder (6.3) is properly located below the filtration vessel.

NOTE — The correct orientation of the membrane filters is that in which the top is viewed on the normal opening of the packaging box.

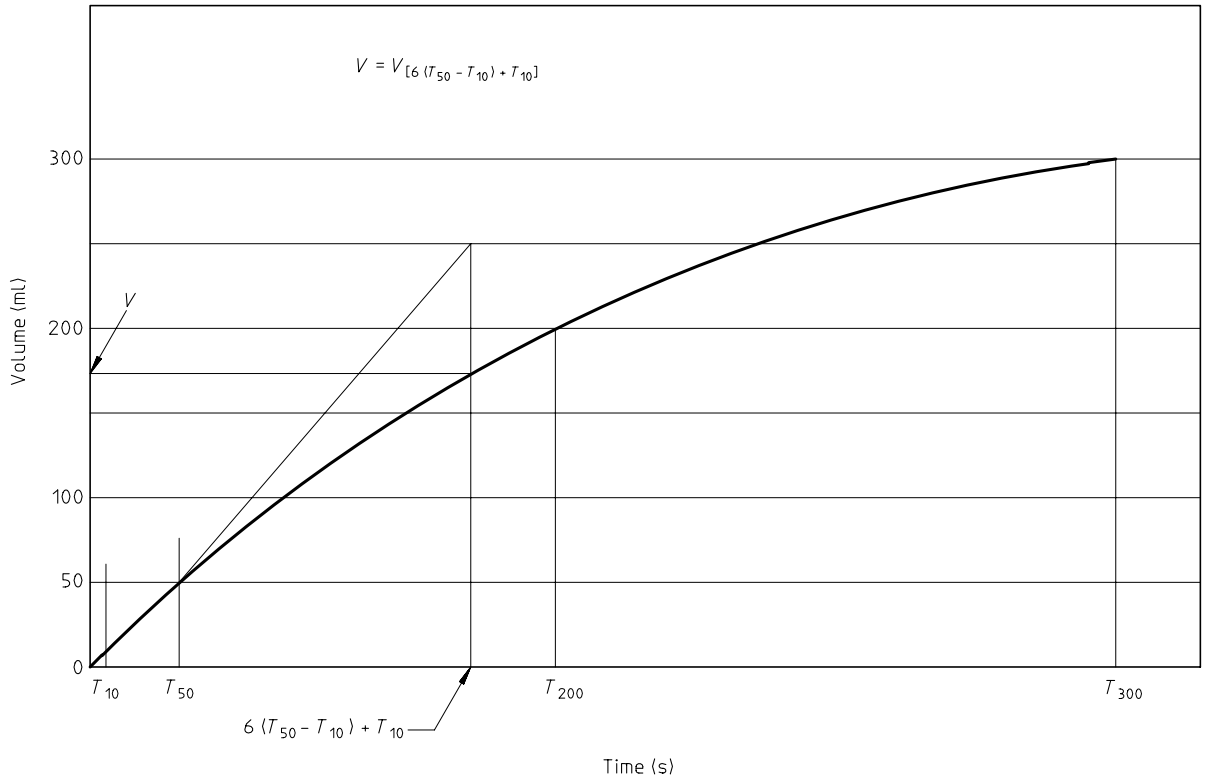


Figure 3 — Diagram of typical filterability test run

9.4 Close the ball valve (see figure 2) and adjust the gas pressure to the specified level, according to the viscosity of the oil. The required pressures, ± 5 kPa, are:

ISO viscosity grades (VG) less than 12	50 kPa
ISO viscosity grades (VG) of 32 and 46	100 kPa
ISO viscosity grades (VG) of 68 and 100	200 kPa

Mix the laboratory sample by inverting the sample container sharply 30 times in 60 s ± 10 s.

NOTE — Each inversion should be completed by a distinct snap.

9.6 Immediately pour 320 ml ± 5 ml of sample into the filtration funnel and close and seal the lid. Open the ball valve and check immediately that the correct pressure is maintained.

9.7 Start the timing device (6.6) when the first drop of oil enters the measuring cylinder.

9.8 Using the dual-stop facility of the timing device, record, to the nearest 0,2 s, the time when the level in the measuring cylinder reaches 10 ml (T_{10}), 50 ml (T_{50}), 200 ml (T_{200}) and 300 ml (T_{300}).

9.9 Immediately T_{50} is available, calculate T_V as $6(T_{50} - T_{10}) + T_{10}$.

9.10 Record the volume in the measuring cylinder at the time (T_V) calculated in 9.9.

9.11 If Stage I filterability only is being measured, discontinue the test when this volume has been recorded.

9.12 Discontinue the test if the time to the highest required volume (either T_V or T_{300}) exceeds 7 200 s (2 h).