INTERNATIONAL STANDARD

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Lubricants, industrial oils and related products — Determination of the foaming and air release properties of industrial gear oils using a spur gear test rig — Flender foam test procedure

Lubrifiants, huiles industrielles et produits connexes — Détermination des caractéristiques de moussage et de désaération des huiles pour engrenages industriels au moyen d'un montage d'essai à engrenage cylindrique — Mode opératoire de l'essai de moussage Flender

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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 12152 was prepared by Technical Committee ISO/TC 28, *Petroleum products and lubricants*.

Introduction

Excessive formation of foam by a lubricant in service may affect the gearbox service negatively. The reason for foaming might be poor antifoaming and air release properties of the lubricant and/or contamination of the lubricant in service. In order to study the foaming properties of lubricants during the formulation work, numerous laboratory glassware tests, e.g. the test procedure used for gear oils that is described in ISO 6247, have been developed. As the foam formation during this test is different to the foam formation in a real gear drive, the demand for a standardized foam test, using test conditions close to those seen in a gear drive, has been increasing. The requirements for lubricants for gearboxes in wind turbines have finally led to this International Standard.

It has been assumed by the compilers of this test method that anyone using the method will be either fully trained and familiar with all normal engineering and laboratory practice, or under the direct supervision of such a person.

It is the responsibility of the operator to ensure that all local legislative requirements are met.

Lubricants, industrial oils and related products — Determination of the foaming and air release properties of industrial gear oils using a spur gear test rig — Flender foam test procedure

1 Scope

This International Standard describes a test method based on a single-stage spur gear rig to determine the foaming properties of oils used for the lubrication of gears.

This method is used for evaluating the foaming and air release properties of lubricating oils, in conditions close to real gearbox conditions.

2 Normative references

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 5725-2, *Accuracy (trueness and precision) of measurement methods and results — Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method*

3 Principle

A set of gears is run with the test lubricant at constant speed and defined oil temperature for a fixed period of time. After the motor has been switched off, the volume increase of the test oil in the gearbox is determined, by distinguishing between oil-air dispersion and surface foam. From this point on, the foam level is recorded at fixed intervals over a period of 90 min.

4 Test materials

4.1 Cleaning fluid, meeting the local safety regulations, e.g. petroleum spirit conforming to ASTM D235.

4.2 Laboratory timer, with an accuracy of at least 1 s, if the test rig is not equipped with an automatic timer.

4.3 Temperature sensing device, capable of monitoring the oil temperature in the gearbox in the range from 0 °C to greater than 40 °C, with an accuracy of ± 0,5 °C or better.

5 Test set-up

The test set-up is shown schematically in Figure 1.

The test apparatus (see Figure 1 and Figure 2) shall comprise a sealed gear unit housing of approx. 2 l volume. Two vertically arranged shafts set in grooved ball bearings shall be located inside the housing. The pair of gears used for the test shall be mounted centrally on the shafts in such a way that with an oil charge of 1 l they are immersed up to the middle of the tooth width. One of the two shafts shall be driven by an electric motor of minimum 0,55 kW at 1450 r/min ± 3 %, which shall be flange-mounted above the housing. The motor and gear shafts shall be connected with a flexible coupling.

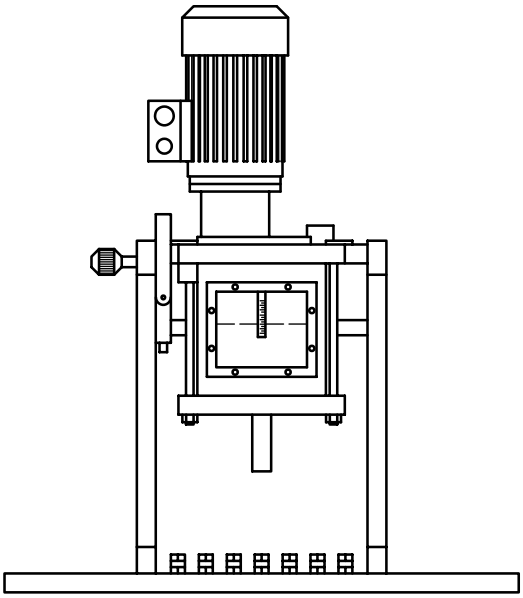
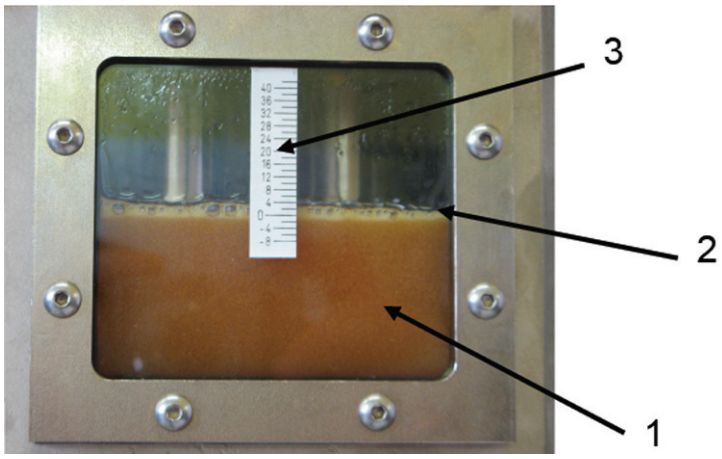


Figure 1 — Foam tester

There shall be a sealed opening with a window on the front of the gearbox housing. The pane shall be provided with a scale from which percentage changes in the volume of the oil can be read during the foam test with an accuracy of ± 1 %. The 0 % line shall indicate the level for an oil sample of approx. 1 l after reaching the temperature of 25 °C ± 0,5 °C, before starting the motor (see Figure 3).

A heating system shall be fitted to the gearbox housing. The oil temperature shall be measured using a suitable temperature sensing device (4.3). An oil filling and drain plug shall be provided for filling and emptying the housing.

Figure 2 — Overall view of a foam tester



Key

1 oil chamber
2 gear set
3 scale

Figure 3 — View of the foam tester oil chamber with gears and percentage scaling by volume

6 Preparation of apparatus

6.1 Clean the rig as specified in the rig manual. Flush the complete gearbox twice with cleaning fluid (4.1), without starting the motor. Air-drying with a water-free air line is effective in removing any remaining cleaning fluid. The rig housing and the gears may be cleaned in a suitable cleaning device.

6.2 Flush the complete gearbox with the candidate oil to be tested, without running the rig.

6.3 Fill the gearbox with approx. 1 l of test oil, up to the 0 % line of the scale.

6.4 If the 0 % line of the front glass scale is not met, correct the oil volume in the gearbox accordingly.

6.5 Close the filling hole by using an adequate air breather.

6.6 Set heating to "ON".

6.7 When the test temperature of (25 ± 0,5) °C is reached, turn heater to "OFF" position.

6.8 If the 0 % line of the front glass scale is not met, correct the oil volume in the gearbox accordingly. Immediately continue with the test procedure given in Clause 7.

7 Test procedure

7.1 Record the oil temperature.

7.2 Start the motor and run for 300 s ± 5 s.

7.3 Record the oil temperature and the volume changes in the gearbox in accordance with Table 1.

7.4 Plot over time the volume change and the volume of oil-air dispersion, as shown in Figure A.1.

7.5 At the end of the test, drain the test oil.

8 Reporting of results

Report the test results to the nearest 1 % in accordance with Table 1 and plot the values in accordance with 7.4. When reporting the total volume increase, do not include the meniscus.

NOTE An example of a test report is given in Annex A.

Table 1 — Test results

Time	Temperature °C	Volume changes %		
		Total increase	Increase due to oil-air dispersion	Increase due to surface foam
At start of test			—	—
After 5 min running time			—	—
After 1 min standing time				
After 3 min standing time				
After 5 min standing time				
After 10 min standing time				
After 15 min standing time				
After 20 min standing time				
After 30 min standing time				
After 45 min standing time				
After 60 min standing time				
After 90 min standing time				
End of test remarks:				

9 Precision

9.1 General

Values of repeatability (r) and reproducibility (R), as defined in ISO 5725-2, have been calculated for the criteria "Total volume increase after 1 min standing time", based on two round robin tests carried out with industrial gear oils of CKC type VG 220 and VG 320, according to ISO 12925-1.

9.2 Repeatability, r

The difference between two test results obtained by the same operator with the same apparatus under constant operating conditions on identical test material shall, in the long run, in the normal and correct operation of the test method, exceed the following value in no more than one case in twenty: $r = 5$ % points.

NOTE Regarding **repeatability**, two results are acceptable if they do not differ by more than 5 % points from each other.

EXAMPLE 12 % foam and 17 % foam are test results within the repeatability of the method.

9.3 Reproducibility, R

The difference between two single and independent results obtained by different operators working in different laboratories on identical test material shall, in the long run, in the normal and correct operation of the test method, exceed the following value in no more than one case in twenty: $R = 10$ % points.

NOTE Regarding **reproducibility**, two results are acceptable if they do not differ by more than 10 % points from each other.

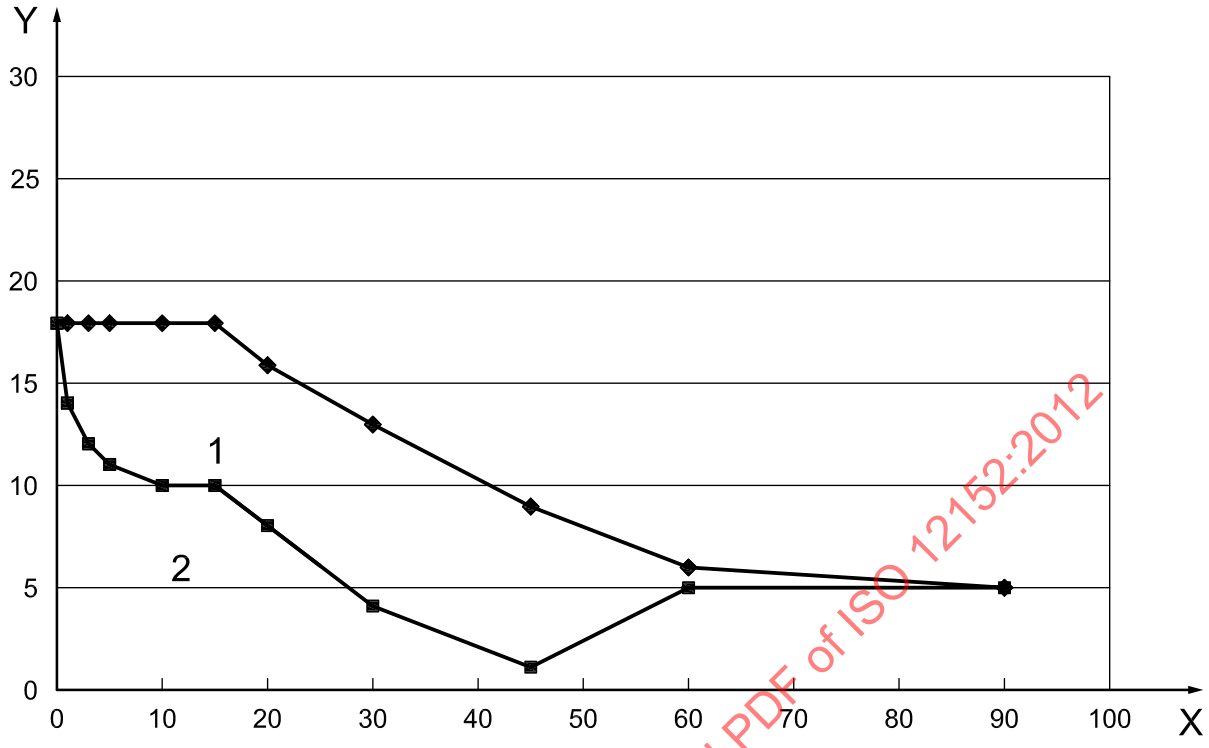
EXAMPLE 12 % foam and 22 % foam are test results within the reproducibility of the method.

Annex A
(informative)

Example of a test report

Oil identification	
Viscosity grade	
Test required by	
Comments (new/used oil, application, etc.)	
Operator	
Date	

Time	**Temperature** °C	**Volume changes** %		
		Total increase	Increase due to oil-air dispersion	Increase due to surface foam
At start of test			—	—
After 5 min running time			—	—
After 1 min standing time				
After 3 min standing time				
After 5 min standing time				
After 10 min standing time				
After 15 min standing time				
After 20 min standing time				
After 30 min standing time				
After 45 min standing time				
After 60 min standing time				
After 90 min standing time				
End of test remarks:				



Key

X time (min)
Y volume increase (%)
1 foam
2 oil-air dispersion

Figure A.1 — Plot example "Volume changes of surface foam and oil-air mixture during observation time after stopping the motor (after 5 min running time)"