Specification for

Turbine lubricants

ICS 75.100

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee PTI/7, Lubricants and process fluids, upon which the following bodies were represented:

Agricultural Engineers Association
Ball and Roller Bearing Manufacturers Association
British Fluid Power Association
British Gear Association
British Lubricants Federation Limited
Institute of Petroleum
London Transport
Ministry of Defence
United Kingdom Petroleum Industry Association Ltd.

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The following BSI references relate to the work on this standard:
Committee reference PTI/7
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Contents

Foreword

This British Standard has been prepared by Technical Committee PTI/7, Lubricants and process fluids. This revision supersedes BS 489:1983 which is withdrawn.

A list of organizations represented on this Technical Committee can be obtained on request to its secretary.

This standard was first published in 1933 under the title "Turbine oils" and specified straight hydrocarbon oils of petroleum origin, without additives, for use in turbines.

The first revision was published in 1955 under the title "Steam turbine oils", and recognized the need, for this application, for oils containing additives designed to inhibit corrosion of the plant and to retard oxidation of the lubricants. Besides specifying such treated oils by description it introduced new tests to suit these additive-containing oils.

It was revised in 1968, 1974 and 1983.

The committee considered implementing ISO 8068:1987 as a revision of this standard and decided that it did not adequately meet the needs of British industry.

The principal changes between this edition and the 1983 edition include:

a) the methods of test have been updated;

b) the minimum viscosity index has been increased to 90;

c) the method for the determination of flash point has been changed to the Cleveland open cup method and the minimum changed to 185 °C;

d) the copper corrosion classification has been changed to "1";

e) the determination of "Total acid" has been replaced by the determination of "Acid number";

f) the maximum foaming characteristics have been reduced;

g) the air release value for the 68 viscosity grade has been reduced to 7;

h) the maximum "Total oxidation products" and "Sludge" have been reduced.

CAUTION In relation to potential health hazards and to precautions recommended for persons regularly in contact with mineral oils over long periods, attention is drawn to the following advisory notices which are available from the Health and Safety Executive:

a) Preventing dermatitis at work — Advice for employers and employees [1];

b) Skin cancer caused by oil [2].

A British Standard does not purport to include all necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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 5 and a back cover.

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1 Scope

This British Standard specifies lubricants for steam turbines in four grades of differing viscosity ranges, but does not cover lubricants of the extreme pressure (EP) type, or applications involving process gases which react with the base oil or additives.

2 Normative references

The following normative documents contain provisions which, through reference in the text, constitute provisions of this British Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the publication referred to applies.

BS 2000-15, *Methods of test for petroleum and its products — Petroleum products — Determination of pour point.*

BS 2000-19, *Methods of test for petroleum and its products — Determination of demulsibility characteristics of lubricating oil.*

BS 2000-135:1993, *Methods of test for petroleum and its products — Determination of rust-preventing characteristics of steam turbine oils in the presence of water.*

BS 2000-146, *Methods of test for petroleum and its products — Determination of foaming characteristics of lubricating oils.*

BS 2000-177, *Methods of test for petroleum and its products — Determination of acid number — Potentiometric titration method.*

BS 2000-226, *Methods of test for petroleum and its products — Petroleum products — Calculation of viscosity index from kinematic viscosity.*

BS 2000-280, *Methods of test for petroleum and its products — Petroleum products and lubricants — Inhibited mineral turbine oils — Determination of oxidation stability.*

BS 2000-313, *Methods of test for petroleum and its products — Determination of air release value of hydraulic, turbine and lubricating oils.*

BS 4231, *Classification for viscosity grades of industrial liquid lubricants.*

BS EN ISO 2160, *Petroleum products — Corrosiveness to copper — Copper strip test.*

BS EN ISO 3104, *Petroleum products — Transparent and opaque liquids — Determination of kinematic viscosity and calculation of dynamic viscosity.*
[BS 2000-71-1]

BS EN ISO 3170, *Petroleum liquids — Manual sampling.*

BS EN ISO 4259, *Petroleum products — Determination and application of precision data in relation to methods of test.*
[BS 2000-367]

BS EN 22592, *Petroleum product — Determination of flash and fire points — Cleveland open cup method.*
[BS 2000-403]

3 Sampling

For the purposes of this British Standard all sampling shall be carried out in accordance with the relevant procedures and precautions described in BS EN ISO 3170.

4 Composition

The lubricants shall be a mineral hydrocarbon oil with additives to comply with the requirements of this standard.

NOTE The additives should be uniformly dispersed at all temperatures above specified pour point up to 120 °C.

The effect of rust-preventing additives shall not be impaired by water washing when the sample is tested according to the modified method described in annex A.

5 Appearance

On visual inspection the lubricant shall be clear and free from water, suspended matter, dirt and sediment.

6 Physical and chemical characteristics

When tested in accordance with the methods given in Table 1, the lubricant shall comply with the limiting requirements given in that table for the appropriate viscosity grade.

7 Precision and interpretation of results

Most of the methods given in Table 1 contain a statement of the precision, i.e. repeatability and reproducibility, to be expected from them but, in case of dispute, the procedure described in BS EN ISO 4259, which uses precision data in the interpretation of test results, shall be used.

8 Designation

Lubricants shall be designated according to their particular viscosity in accordance with the classification given in BS 4231, i.e. a number corresponding to the mid-point of kinematic viscosity at 40 °C (e.g. VG 32).

9 Packaging and marking

The lubricant shall be supplied either in bulk, or in clean sound and dry containers.

If the lubricant is supplied in containers, each container shall be legibly and durably marked with the following:

a) the number and year of this British Standard, i.e. BS 489:1999[1)];

b) the type and grade designation, e.g. TO/ISO VG 32;

c) the name or mark of the supplier or vendor of the lubricant and the batch or consignment number.

1) Marking BS 489:1999 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is solely the claimant's responsiblity. Such a declaration is not to be confused with third-party certification of conformity.

Table 1 — Physical and chemical characteristics

Type prefix		TO	TO	TO	TO	Test method
Viscosity grade no. (ISO VG) (BS 4231)		32	46	68	100	
Viscosity, kinematic at 40 °C, mm^2/s	min.	28.8	41.4	61.2	90	BS EN ISO 3104
	max.	35.2	50.6	74.8	110	
Viscosity index	min.	90	90	90	90	BS 2000-226
Flash point Cleveland open cup method	min.	185 °C	185 °C	185 °C	185 °C	BS EN 22592
Pour point	max.	−6 °C	−6 °C	−6 °C	−6 °C	BS 2000-15
Demulsification Number *s*	max.	300	300	360	360	BS 2000-19
Copper corrosion		1	1	1	1	BS EN ISO 2160
Acid number, mg KOH/g	max.	0.45	0.45	0.45	0.45	BS 2000-177
Rust-preventing characteristics		Pass	Pass	Pass	Pass	BS 2000-135, procedure B as amended by annex A
Foam characteristics:						BS 2000-146
Foaming tendency:						
Foam, ml						
As received						
Sequence I max.		400	400	400	400	
Sequence II max.		50	50	100	100	
Sequence III max.		400	400	400	400	
Foam stability after 10 min:						
Foam, ml						
As received						
Sequence I max.		Nil	Nil	20	30	
Sequence II max.		Nil	Nil	10	10	
Sequence III max.		Nil	Nil	20	30	
Air release value, Minutes to 0.2 % air content at 50 °C max.		5	6	7	10	BS 2000-313
Oxidation characteristics:						BS 2000-280
Total oxidation products (TOP) % (*m/m*), max.		0.70	0.80	0.80	0.80	
Sludge % (*m/m*), max.		0.30	0.35	0.35	0.35	

Annex A (normative)

Method of test for rust-preventing characteristics: modifications to the BS 2000-135 procedure

A.1 Principle

The following modifications to the procedure described in BS 2000-135 are considered necessary for the purpose of this standard, but have not at present been accepted for the joint method IP 135:ASTM D665 with which BS 2000-135 is identical.

The effect of these modifications is that the steel test specimen is immersed for 30 min to 60 min in a portion of the lubricants sample "as received" and is then transferred to another portion that has been washed with distilled water at a temperature of 90 °C ± 1 °C. The test procedure described in BS 2000-135, using synthetic sea water (except as provided for in the note to Table 1), is then continued. The purpose of the water-washing stage is to remove water-extractable additives, as is likely to happen in practice when using turbine oils in a "wet" system.

A.2 Apparatus

The apparatus used shall be in accordance with BS 2000-135:1993, section 3.

A.3 Test specimen and its preparation

The test specimen shall be prepared in accordance with BS 2000-135:1993, **5.2**, **5.3** and **5.4**, where the last paragraph of **5.4** and NOTE 9 are replaced by the following.

"Remove the specimen from the chuck without touching it with the fingers, wipe lightly with a clean, dry lintless cloth or tissue (or brush the specimen lightly with a camel hair brush), attach it to the holder and immediately immerse it in a portion of the original sample to be tested; remove it 30 min to 60 min later and allow it to drain briefly before placing it in the hot water-washed sample as described in **6.1**."

A.4 Procedure

A.4.1 *Distilled water*

Follow the procedure given in BS 2000-135:1993, **6.1** but in **6.1.1** replace the fourth sentence by the following two paragraphs.

"Stir 310 ml of the lubricants to be tested with 50 ml of distilled water for 30 min at a temperature of 90 °C ± 1 °C, using the beaker, stirrer and stirrer speed specified in clause **3**.

Transfer the mixture of lubricants and water to a separating funnel and leave to separate. Draw off the water layer. Pour 300 ml of the water-washed lubricants into a clean beaker and place the beaker in the lubricants bath held at a temperature that will maintain a temperature of 60 °C ± 1 °C in the lubricants sample."

A.4.2 *Synthetic sea water*

Follow the procedure given in BS 2000-135:1993, **6.2** and **6.3** but read the reference to **6.1.1** as including the modification set out in **A.4.1**.

A.5 Test report

The test report shall be produced in accordance with BS 2000-135:1993, clause **9** but with **9**b) replaced by the following text.

"The report of results should indicate that the test has been carried out in accordance with BS 2000-135 as modified by BS 489:1999, annex A."

Bibliography

Standards publications

ISO 8068:1987, *Petroleum products and lubricants — Petroleum lubricating oils for turbines (categories ISO-L-TSA and ISO-L-TGA) — Specifications.*

Other non-standards publications

[1] HSE BOOKS. Preventing dermatitis at work — Advice for employers and employees, INDG 233, 1996.
[2] HSE BOOKS. Skin cancer caused by oil, INDG 300, 1999.

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