

BS EN ISO 4404-2:2010



BSI Standards Publication

Petroleum and related products — Determination of the corrosion resistance of fire- resistant hydraulic fluids

Part 2: Non-aqueous fluids (ISO
4404-2:2010)

bsi.

...making excellence a habit.™

National foreword

This British Standard is the UK implementation of EN ISO 4404-2:2010. It supersedes BS EN ISO 4404-2:2003 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee MCE/18/-/16, Hydraulic fluids.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© BSI 2011

ISBN 978 0 580 71336 1

ICS 75.120

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 January 2011.

Amendments issued since publication

Date	Text affected
------	---------------

English Version

**Petroleum and related products - Determination of the corrosion
resistance of fire-resistant hydraulic fluids - Part 2: Non-aqueous
fluids (ISO 4404-2:2010)**

Pétrole et produits connexes - Détermination de la
résistance à la corrosion de fluides hydrauliques
difficilement inflammables - Partie 2: Fluides non aqueux
(ISO 4404-2:2010)

Mineralölerzeugnisse und verwandte Produkte -
Bestimmung der korrosionsverhindernden Eigenschaften
von schwer entflammaren Druckflüssigkeiten - Teil 2:
Nicht-wässrige Flüssigkeiten (ISO 4404-2:2010)

This European Standard was approved by CEN on 13 December 2010.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

Foreword

This document (EN ISO 4404-2:2010) has been prepared by Technical Committee ISO/TC 28 “Petroleum products and lubricants” in collaboration with Technical Committee CEN/TC 19 “Gaseous and liquid fuels, lubricants and related products of petroleum, synthetic and biological origin” the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2011, and conflicting national standards shall be withdrawn at the latest by June 2011.

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

This document supersedes EN ISO 4404-2:2003.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

Endorsement notice

The text of ISO 4404-2:2010 has been approved by CEN as a EN ISO 4404-2:2010 without any modification.

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 4404-2 was prepared by Technical Committee ISO/TC 28, *Petroleum products and lubricants*.

This second edition cancels and replaces the first edition (ISO 4404-2:2003), of which it constitutes a minor revision.

ISO 4404 consists of the following parts, under the general title *Petroleum and related products — Determination of the corrosion resistance of fire-resistant hydraulic fluids*:

- *Part 1: Water-containing fluids*
- *Part 2: Non-aqueous fluids*

Petroleum and related products — Determination of the corrosion resistance of fire-resistant hydraulic fluids —

Part 2: Non-aqueous fluids

WARNING — The use of this part of ISO 4404 may involve hazardous materials, operations and equipment. This part of ISO 4404 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 4404 to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1 Scope

This part of ISO 4404 specifies a procedure for the determination of the corrosion-inhibiting properties of non-aqueous hydraulic fluids within the category HFD, as classified in ISO 6743-4.

It provides a qualitative assessment of corrosion of five of the most common metals used in the construction of hydraulic systems, but other metals and/or alloys could be added or substituted for these metals for particular installations.

NOTE The determination of corrosion resistance of aqueous hydraulic fluids within categories HFA, HFB and HFC is described in ISO 4404-1.

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 3170:2004, *Petroleum liquids — Manual sampling*

ISO 3819:1985, *Laboratory glassware — Beakers*

ISO 5272:1979, *Toluene for industrial use — Specifications*

3 Principle

Test pieces of selected metals are polished, weighed and immersed, separately and in pairs, in the test fluid for 672 h at 35 °C. At the end of the test period, the change in mass of the test piece is recorded and the appearance of both the test pieces and test fluid is assessed against arbitrary classification scales.

4 Reagents and materials

4.1 **Heptane**, commercial grade.

4.2 **Toluene**, conforming to the requirements of grade 2 of ISO 5272.

4.3 **Abrasive cloth or paper**, made of silicon carbide, of nominal grit sizes 125 µm, 65 µm, 37 µm and 26 µm.

NOTE Papers and cloths are often sold against arbitrary grit sizes. The above-mentioned (4.3) represent P 120, P 240, P 400 and P 600, respectively.

4.4 **Absorbent cotton (cotton wool)**.

5 Apparatus

5.1 **Beakers**, of capacity 400 ml, made of borosilicate glass, generally conforming to the requirements of ISO 3819, approximately 135 mm in height, without spouts.

5.2 **Watch-glasses**, of diameter 90 mm to 110 mm, with a hole of approximately 8 mm diameter, drilled centrally (see second paragraph of 5.3).

5.3 **Glass hooks**, shaped to allow free suspension of the test pieces in the beaker, either directly, or by means of the spacer (5.4), and having a spherical suspension end of diameter 12 mm to 15 mm.

The combination of the hole in the watch-glass and/or shim, and the spherical end of the glass hook, should provide an effective closure.

5.4 **Spacers and bolts**, made of nylon, spacers 15 mm × 10 mm × 1 mm with two holes of 5 mm in diameter and 8 mm apart, each spacer fitted with a nylon bolt of 4 mm in diameter. Nylon spacer(s) [shim(s)], with a centrally drilled 8 mm diameter hole, may be needed to adjust the height of the test specimens in the beaker (see item 2 in Figure 1).

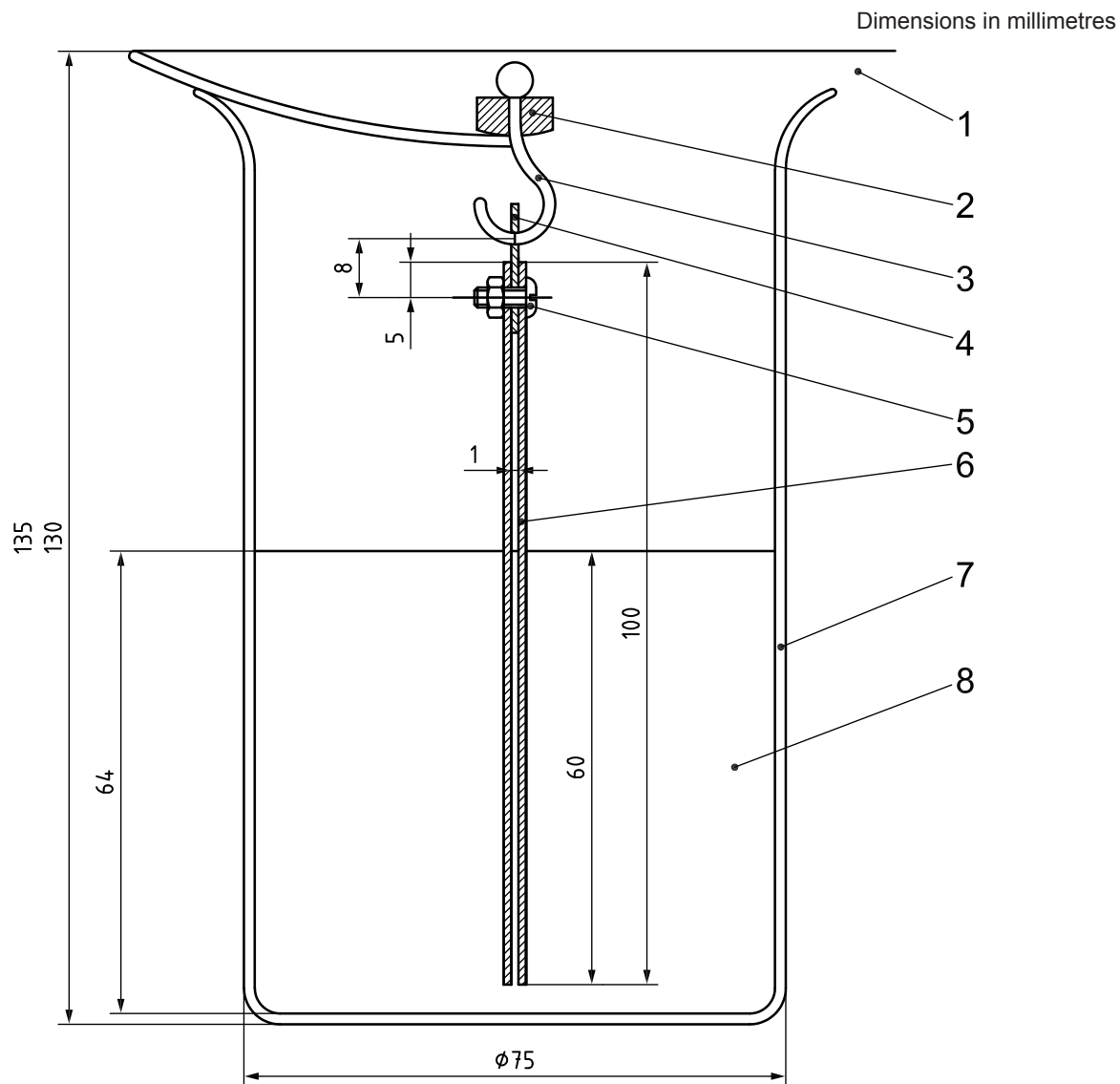
5.5 **Heating bath**, consisting of a thermostatically controlled bath or oven of sufficient capacity to accommodate at least 10 beakers, and capable of maintaining a temperature of (35 ± 1) °C throughout the test period. The bath shall be equipped with a stirrer, or the oven with a fan, to ensure even temperature distribution in all areas. At least four temperature sensors are required.

5.6 **Analytical balance**, capable of weighing to the nearest 0,2 mg.

5.7 **Forceps**, spade-ended or round-ended, either corrosion-resistant metal or plastic, with plain inner faces.

6 Test pieces

The test pieces shall be rectangles of the selected metals, 100 mm in length, 20 mm in width and 1 mm to 2 mm in thickness, with a hole 4 mm to 5 mm in diameter located centrally at one end, approximately 5 mm from the edge. The composition of the five standard metals is given in Table 1.



Key

- 1 watch-glass
- 2 shim
- 3 glass hook
- 4 nylon spacer (15 × 10 × 1)
- 5 nylon bolt and nut, diameter 4
- 6 pair of test strips
- 7 beaker without a spout
- 8 test fluid

Figure 1 — Illustrative arrangement of test pieces in the beaker

7 Samples and sampling

7.1 Unless otherwise specified, samples shall be obtained by the procedures described in ISO 3170.

7.2 A minimum laboratory sample size of 3 l is required for this test, and this shall be prepared in a single container at the sampling site.

8 Preparation of test pieces

8.1 Select 13 test pieces (Clause 6): four of zinc, three each of steel and aluminium, two of copper and one of brass, and polish the edges with a coarse abrasive cloth or paper (4.3) to remove any burr and finish with 26 µm cloth or paper. Ensure that the cloth or paper used for one metal does not come into contact with any other metal.

8.2 Polish the surfaces of each test piece with abrasive cloth or paper in order of fineness, finishing with 26 µm cloth or paper. From this point, handle the test pieces only with the forceps (5.7).

The selection of the coarser grades of cloth or paper depends on the original surface condition of the test piece being polished, but it is recommended that at least two coarser grades be used before the final polishing.

8.3 Rub the surfaces of the polished test piece with absorbent cotton (4.4) followed by absorbent cotton soaked in heptane (4.1). Rinse the test piece in heptane and dry in a current of warm dry air.

Prepared test pieces should have a maximum time between preparation and the test procedure. They may be kept after preparation, for up to 30 min immersed in heptane, but care should be taken to ensure that no contact occurs between test pieces of different metals.

Table 1 — Composition of metal test pieces

Metal	Composition	
	% (m/m)	
Steel	C	0,35 to 0,45
	Mn	0,50 to 0,80
	Si max.	0,10
	S max.	0,035
	P max.	0,035
Copper	Cu min.	99,9
	(Electrolytic grade)	
Brass	Cu	65 ± 0,5
	Zn	35 ± 0,5
Zinc	Zn min.	99,5
Aluminium	Al min.	99,5
NOTE For the purposes of this part of ISO 4404, the term “%(m/m)” represents the mass fraction of a material.		

9 Procedure

9.1 Weigh each dry test piece to the nearest 0,2 mg.

9.2 Pour (250 ± 10) ml of test fluid into each of the 10 beakers.

9.3 In five beakers, place one test piece of each metal on the hook (5.3) suspended from the watch-glass (5.2) such that (60 ± 3) mm of the test piece is immersed in the test fluid, and the test piece is a minimum of 3 mm from the bottom of the beaker. Figure 1 gives an illustrative layout of test pieces in the beaker.

9.4 Prepare four pairs of metal test pieces by means of the nylon spacers and bolts (5.4), with the second hole in the spacer used for suspension. Check that the distance between the two test pieces is uniform and not less than 1 mm. The four pairs are

- steel and zinc,
- copper and zinc,
- aluminium and zinc, and
- steel and aluminium.

9.5 Suspend the pairs of test pieces in the test fluid with the same immersion conditions as the single test pieces.

Because of the lower suspension of the test pieces on the hook, the use of a spacer between the spherical end of the hook and the hole in the watch-glass (5.2) is generally required. The spacer chosen should maintain the effective closure.

9.6 Place the 10 beakers, nine containing test pieces and one of test fluid only, in the heating bath or oven (5.5) and check that the temperature of the chamber is evenly distributed at (35 ± 1) °C, within 30 min. Maintain the test conditions for (672 ± 2) h.

9.7 At the end of the test period, remove the test pieces from the test fluid, disassemble the pairs, and lay them all out on a white absorbent paper. Examine each test piece in the two zones (liquid exposure and vapour exposure) and record the corrosion according to the classification given in Table 2.

9.8 Examine each beaker of test fluid and record the condition according to the classification given in Table 3.

9.9 Rinse each test piece, held by the forceps in the vicinity of the suspension hole, in toluene (4.2), taking care not to disturb any deposits on the surface. Dry in a stream of warm dry air and reweigh to the nearest 0,2 mg.

Table 2 — Test-piece corrosion classification

Classification	Description
0	No change
1	Slight colour change or oxidation of less than 20 % of surface
2	Strong colour change
3	Deposits or oxidation of more than 20 % of surface
4	Corrosion or pitting
5	Other effects (specify, if applicable)

Table 3 — Test-fluid condition classification

Classification	Description
0	No change
1	Deposits
(2)	Separation (not applicable to HFD fluids)
3	Cloudiness
4	Colour change
5	Other effects (specify, if applicable)

10 Expression of results

10.1 Report all results obtained for the test pieces and fluids. For each result concerning a metal test piece, identify whether the test was carried out on a single metal test piece or a paired test piece. For paired test pieces, identify the other metal. For results concerning the fluids, report the metal or metal pair immersed or whether there was no metal immersed (blank test).

10.2 Report the change in mass of each test piece to the nearest 0,5 mg.

10.3 Report the corrosion classification of each test piece, in each of the two zones.

10.4 Report the test fluid condition classification.

11 Test report

The test report shall contain at least the following information:

- a) a reference to this part of ISO 4404, i.e. ISO 4404-2:2010;
- b) the type and complete identification of the product tested;
- c) the test result (see Clause 9);
- d) any deviation, by agreement or otherwise, from the procedure specified;
- e) the date of the test.

Bibliography

- [1] ISO 6743-4, *Lubricants, industrial oils and related products (class L) — Classification — Part 4: Family H (Hydraulic systems)*

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards-based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

All the data, software and documentation set out in all British Standards and other BSI publications are the property of and copyrighted by BSI, or some person or entity that owns copyright in the information used (such as the international standardization bodies) and has formally licensed such information to BSI for commercial publication and use. Except as permitted under the Copyright, Designs and Patents Act 1988 no extract may be reproduced, stored in a retrieval system or transmitted in any form or by any means – electronic, photocopying, recording or otherwise – without prior written permission from BSI. Details and advice can be obtained from the Copyright & Licensing Department.

Useful Contacts:

Customer Services

Tel: +44 845 086 9001

Email (orders): orders@bsigroup.com

Email (enquiries): cservices@bsigroup.com

Subscriptions

Tel: +44 845 086 9001

Email: subscriptions@bsigroup.com

Knowledge Centre

Tel: +44 20 8996 7004

Email: knowledgecentre@bsigroup.com

Copyright & Licensing

Tel: +44 20 8996 7070

Email: copyright@bsigroup.com



...making excellence a habit.™