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

**Part 1:  
Water-containing fluids**

*Pétrole et produits connexes — Détermination de la résistance  
à la corrosion de fluides hydrauliques difficilement inflammables —  
Partie 1 Fluides contenant de l'eau*

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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 4404-1 was prepared by Technical Committee ISO/TC 28, *Petroleum products and lubricants*.

This second edition cancels and replaces the first edition (ISO 4404-1:2001), which has been technically revised.

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*

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## Introduction

Water-containing hydraulic fluids are used in systems where fire resistance is required due to operating conditions. The corrosion resistance of such fluids has to be assessed in order to choose a suitable system design and prepare maintenance instructions.

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

## Part 1: Water-containing 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 test method to determine the influence on metals of fire-resistant fluids in categories HFA, HFB and HFC, as classified in ISO 6743-4. It evaluates the corrosion protection provided by these fluids towards metal components used in hydraulic systems and installations.

A similar technique for fluids in category HFD is described in ISO 4404-2.

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### 2 Normative references (standards.iteh.ai)

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 648: 2008, *Laboratory glassware — Single-volume pipettes*

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

ISO 3819: 1985, *Laboratory glassware — Beakers*

ISO 5598: 2008, *Fluid power systems and components — Vocabulary*

ISO 6344-1: 1998, *Coated abrasives — Grain size analysis — Part 1: Grain size distribution test*

ISO 20783-1: 2011, *Petroleum and related products — Determination of emulsion stability of fire-resistant fluids — Part 1: Fluids in category HFAE*

DIN 12331: 1988, *Laboratory glassware; beakers*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5598:2008 apply.

## 4 Principle

Test strips of appropriate metals, both singly and in pairs, are partially submerged in the test fluid at a specific temperature and for a specific period. The change in mass of each test strip, its surface appearance and the change in the appearance of the fluid during the test are determined.

NOTE 1 When assessing the corrosivity of HFAE and HFAS fluids, it may be necessary to dilute an additive concentrate with water and the quality of the water can significantly affect the test results. The diluent, therefore, needs to be chosen carefully and, preferably, to be representative of commercial use. The selection could be one of the test waters listed in Annex A, deionized water or mains water as agreed between the user and the fluid supplier.

NOTE 2 The selection of the metals for corrosion testing may depend on the application and on the type of fluid being tested. For example, aluminium may not be used in mining applications while contact between HFC fluids and zinc shall be minimized as far as possible.

## 5 Reagents and materials

5.1 **Acetone**, analytical grade.

5.2 **Heptane**, analytical grade.

5.3 **Water**, selected from one of the following:

- a) a test water of composition specified in Annex A,
- b) deionized water conforming to grade 3 of ISO 3696:1987, or
- c) the supply water to be used commercially.

5.4 **Metal salts** (listed in Table A.1), analytical grade.

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## 6 Apparatus

6.1 **Glass beakers**, of capacity 400 ml, height approximately 135 mm, without a spout, conforming to ISO 3819:1985 (see Figure 1). A maximum of ten is required for each test fluid.

6.2 **Glass beaker**, type H 1000, conforming to DIN 12331:1988 (of capacity 1 000 ml).

6.3 **Pipette**, complying with ISO 648:2008, class A.

6.4 **Watch glasses** (ten required), for covering the beakers (6.1), with a hole in the centre for suspending glass hooks (6.5) (see Figures 1 and 2).

6.5 **Glass hooks**, allowing free suspension of the test strips in the beaker and formed in such a way that the hole in the watch glass will be closed by the suspension device (see Figures 1 and 2).

6.6 **Heating bath or oven**, thermostatically controlled and capable of maintaining the test fluids at  $35\text{ °C} \pm 1\text{ °C}$ . If a heating bath is used, it shall be equipped to allow adequate stirring to ensure even temperature distribution.

6.7 **Shims**, of rubber, cork or plastic, 8 mm thick and 1,5 cm to 2 cm in diameter.

6.8 **Analytical balance**, accurate to 0,000 2 g.

6.9 **Abrasive paper**, of different aluminium oxide grit sizes, including P 120, P 400 and P 600 types according to ISO 6344-1:1998.



**6.10 Cotton wool.**

**6.11 Plastic tweezers**, suitable for handling the test strips.

**6.12 Desiccator**, containing dry silica gel desiccant. Alternatively, a vacuum desiccator may be used.

**6.13 Abrasive wheel (fine)**, rotating at approximately 1 400 r/min.

**6.14 Test strips**, of the materials listed in Table 1, measuring 100 mm × 20 mm × 1 mm and having a hole of 4 mm in diameter at one end for suspending on the glass hook (6.5).

The steel test strips shall be non-heat-treated.

Test strips measuring 100 mm × 20 mm × 2 mm may also be used.

NOTE 1 This test can be performed with any other material (metal and/or alloy) used in hydraulic systems, provided that the dimensions of the test strips are observed as specified in this subclause.

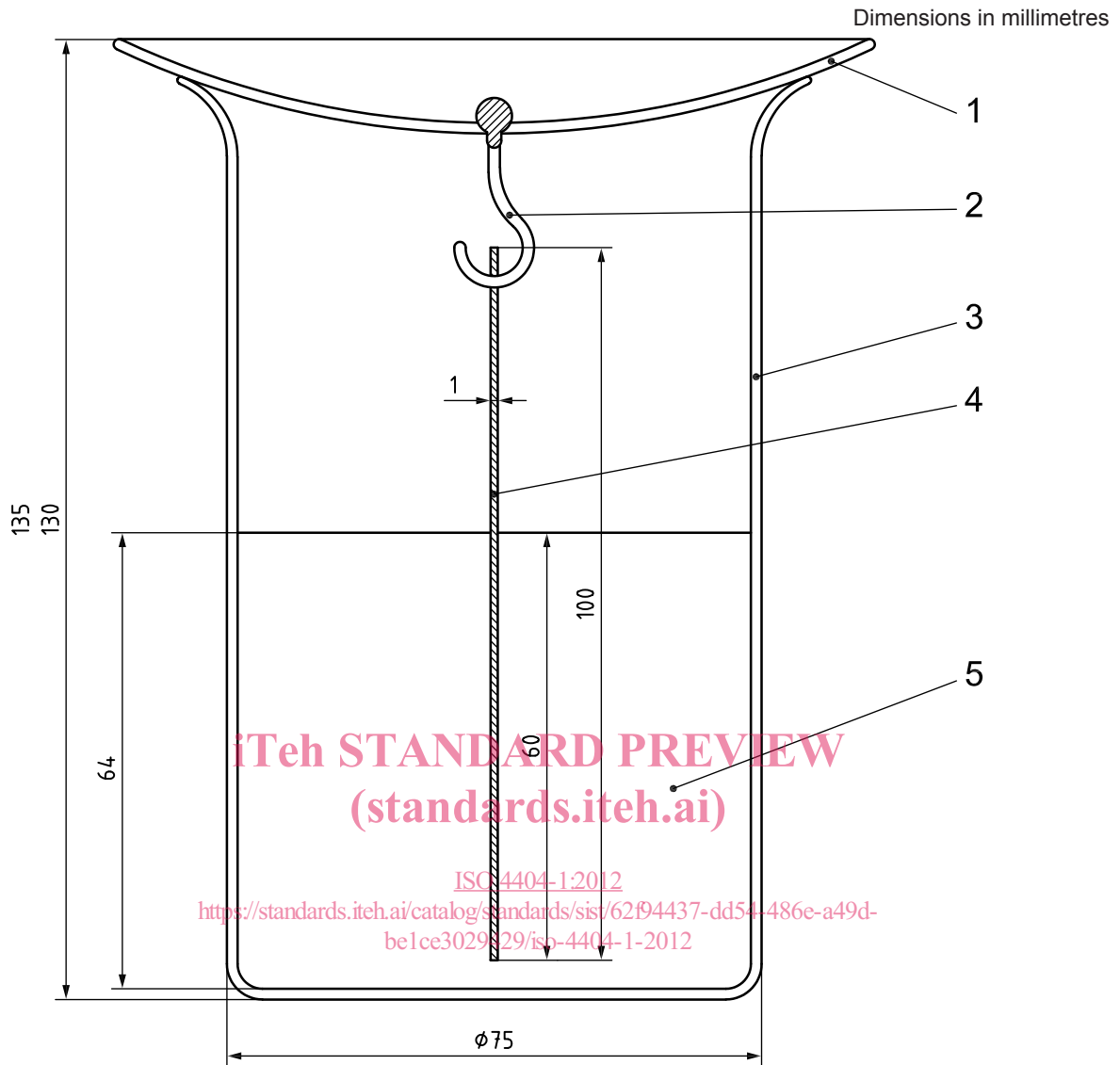
NOTE 2 Zinc reacts chemically with some water-based fluids, particularly water polymer (water glycol) solutions. For this reason, the use of zinc in systems containing HFC fluids is currently limited to small fixtures and fittings.

**6.15 Spacer**, of nylon, rectangular, 15 mm × 10 mm × 1 mm, with two holes of 5 mm in diameter, for the glass hook (6.5) and bolt (6.16) (see Figure 2).

**6.16 Fixing.**

NOTE M4 × 16 machine screw, Nylon 6.6, and plain nut, Nylon 6.6.

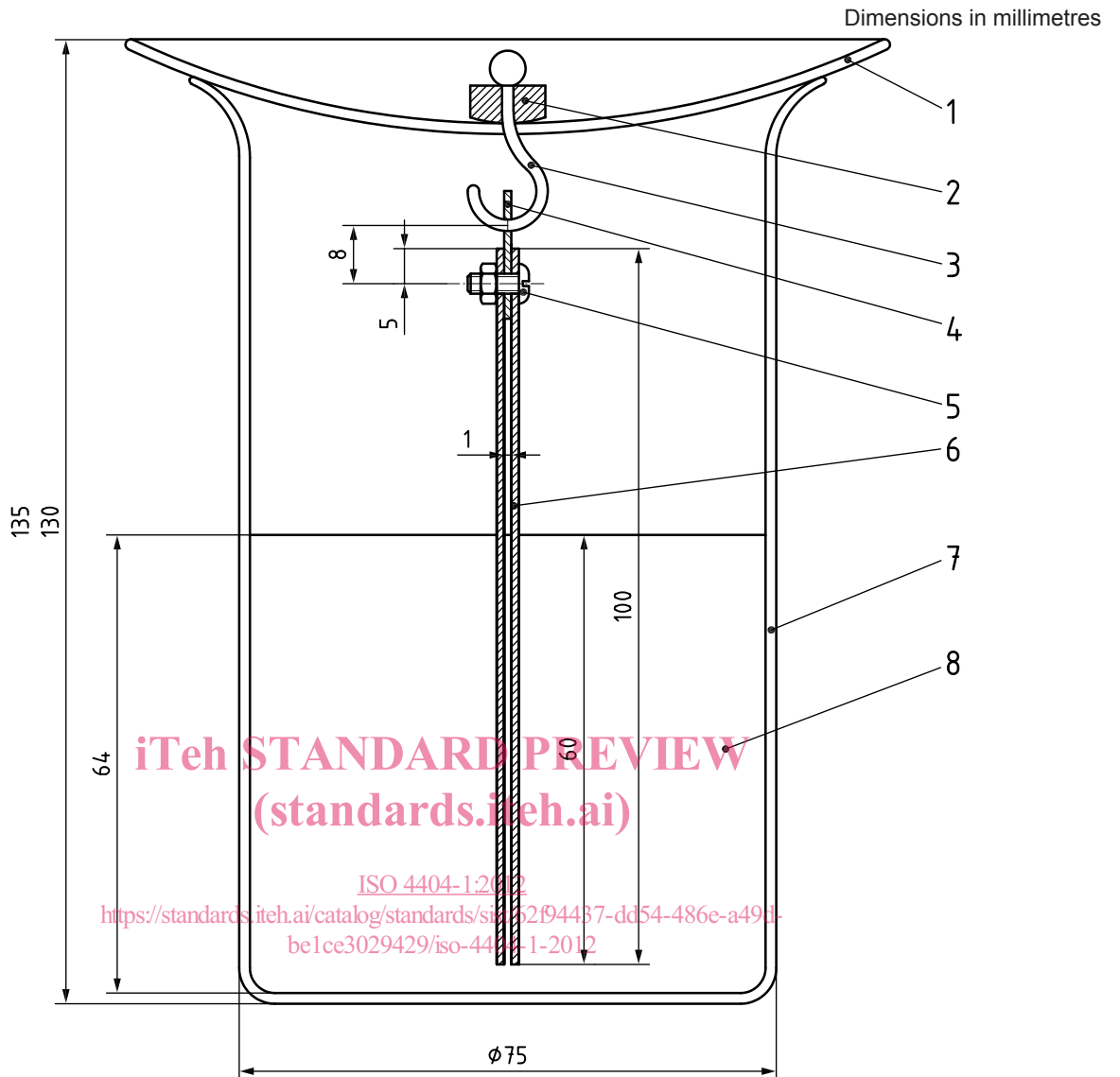
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**Key**

- 1 watch glass
- 2 glass hook
- 3 beaker without a spout
- 4 test strip
- 5 test fluid

**Figure 1 — Assembly for a single test strip**



**Key**

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

**Figure 2 — Assembly for a pair of test strips**