# INTERNATIONAL STANDARD

# ISO 14624-4

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# Space systems — Safety and compatibility of materials —

## Part 4: Determination of upward flammability of materials in pressurized gaseous oxygen or oxygen-enriched environments

*Systèmes spatiaux — Sécurité et compatibilité des matériaux —*

*Partie 4: Détermination de l'inflammabilité verticale des matériaux dans des environnements d'oxygène gazeux pressurisé ou enrichis en oxygène*

Reference number
ISO 14624-4:2003(E)

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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 14624-4 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

ISO 14624 consists of the following parts, under the general title *Space systems — Safety and compatibility of materials*:

— *Part 1: Determination of upward flammability of materials*

— *Part 2: Determination of flammability of electrical-wire insulation and accessory materials*

— *Part 3: Determination of offgassed products from materials and assembled articles*

— *Part 4: Determination of upward flammability of materials in pressurized gaseous oxygen or oxygen-enriched environments*

— *Part 5: Determination of reactivity of materials with aerospace propellants*

— *Part 6: Determination of reactivity of processing materials with aerospace fluids*

— *Part 7: Determination of permeability of materials to aerospace fluids*

# Introduction

Throughout this part of ISO 14624, the minimum essential criteria are identified by the use of the imperative or the key word “shall”. Recommended criteria are identified by the use of the key word “should” and, while not mandatory, are considered to be of primary importance in providing serviceable, economical and practical designs. Deviations from the recommended criteria may be made only after careful consideration, extensive testing and thorough service evaluation have shown an alternative method to be satisfactory.

# Space systems — Safety and compatibility of materials —

# Part 4: Determination of upward flammability of materials in pressurized gaseous oxygen or oxygen-enriched environments

## 1 Scope

This part of ISO 14624 specifies a test method for determining the flammability of aerospace materials in pressurized gaseous oxygen (GOX) and oxygen-enriched environments, at ambient temperature. This method may also be used to provide supplementary information by testing at pressures other than the intended use pressure (see Clause 4). The standard pressure range for this test method is from ambient to 69 000 kPa.

## 2 Conformance

The tests shall be performed in an accredited test facility (see Annex A for guidelines).

The authority having jurisdiction, or the test requester, shall provide properly identified material(s) for testing. Alternatively, accredited test facilities may be authorized by the test requester to procure the appropriate material(s).

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

**3.1**
**burn length**
length of specimen that has been consumed by combustion

NOTE The burn length is determined by subtracting the post-test specimen length from the pre-test specimen length.

**3.2**
**flammable material**
a material is considered to be flammable at a specific pressure if at least one specimen burns more than 150 mm at that pressure

**3.3**
**good laboratory practice**
**GLP**
practice which involves the testing of standard reference materials to verify data accuracy and repeatability

## 4 Principle

In a high-pressure test chamber containing a specific test environment, an ignition source, delivering a defined amount of energy, is applied to the lower end of a vertically oriented test specimen. The maximum post-test burn length for at least 10 standard-sized specimens is recorded. Materials are considered flammable at a specific pressure if at least one specimen burns more than 150 mm. Tests shall be conducted at ambient temperature, in gaseous oxygen or oxygen-enriched environments. The test pressure shall simulate the worst-case environment in which ignition and combustion of the material are likely to occur. To obtain

supplementary information, as well as provide a direct comparison between all the materials tested, specimens may be tested at the appropriate pressures selected from those given in Table 1.

**Table 1 — Test pressures**

| Test pressure<br>kPa |
|---|
| 100 |
| 170 |
| 350 |
| 690 |
| 1 700 |
| 3 500 |
| 6 900 |
| 14 000 |
| 21 000 |
| 35 000 |
| 52 000 |
| 69 000 |

## 5 Reagents

**5.1 Gases**, used for the tests.

## 6 Test system

**6.1 Test chamber and associated equipment**, capable of providing a pressure of up to 69 000 kPa, and having a volume such that no more than 5 % of the available oxygen is consumed during the test. In addition, the test chamber shall not interfere chemically or physically with the test.

**6.2 Specimen holder**, capable of being attached to the top of the specimen and holding it in a vertical position (see Figure 1).

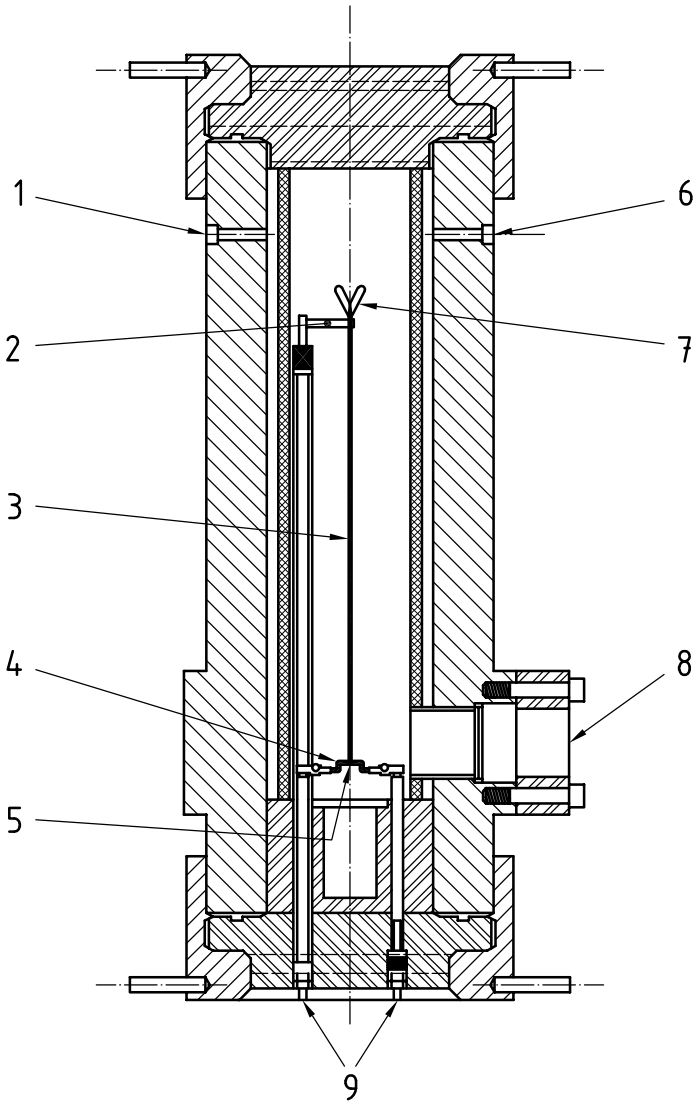
**6.3 Ignition source**, comprising a promoter (6.3.1), an ignitor wire (6.3.2) and a power supply (6.3.3).

**6.3.1 Promoter**, physically attached to the specimen (see Figure 2) and consisting of a sufficient quantity of aluminium or magnesium to release at least 3,0 kJ.

**6.3.2 Ignitor wire**, bare, made of aluminium-palladium or nickel-chromium.

**6.3.3 Power supply**, electrically insulated, capable of providing 40 A (RMS) at 50 V, used to supply current to the ignitor wire (6.3.2).

**6.4 Measuring devices**, such as pressure gauges and oxygen-measuring devices, in proper calibration.

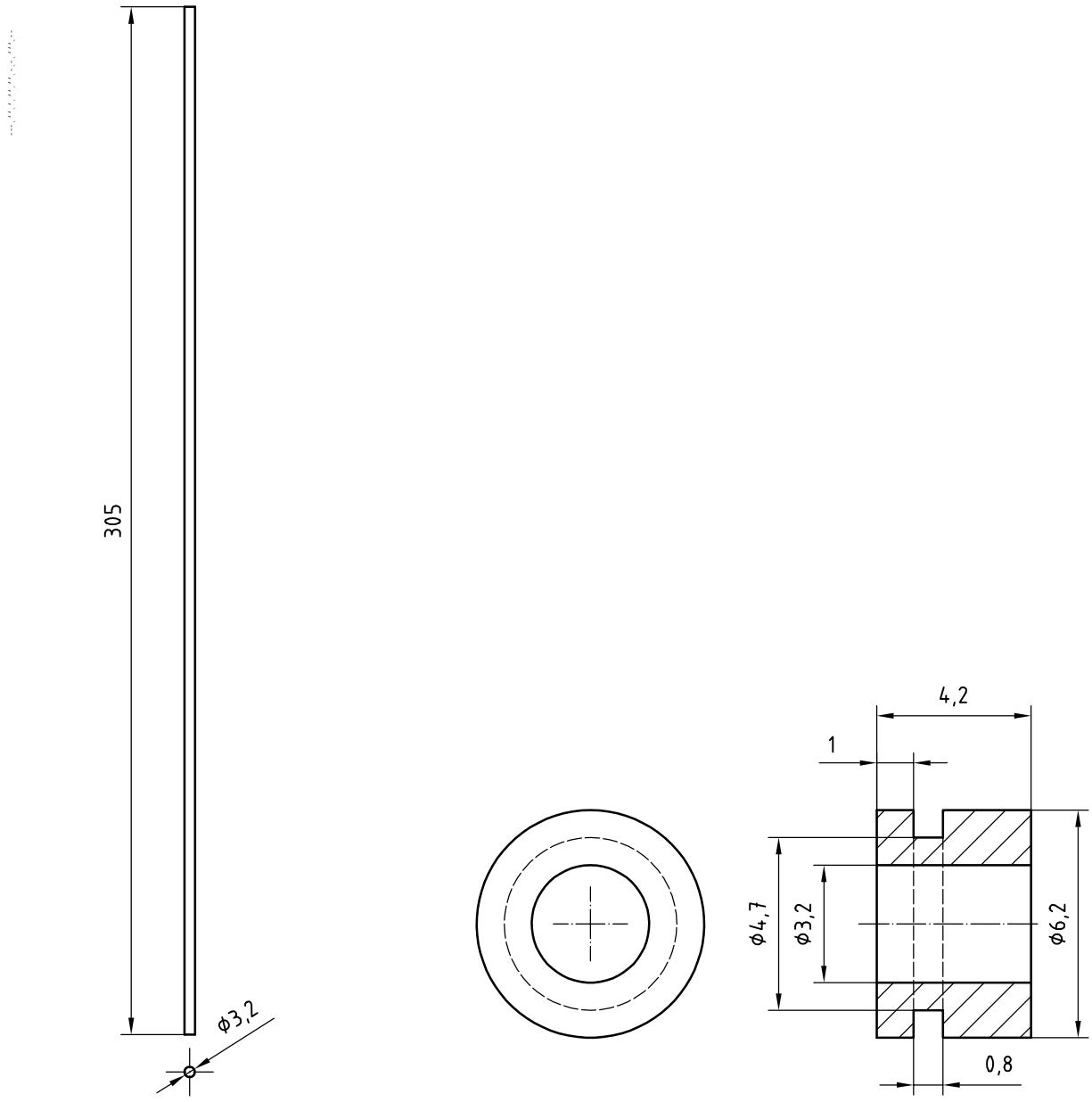



**Key**

1 oxygen supply port
2 ceramic specimen holder
3 test specimen
4 ignitor wire
5 promoter
6 gas outlet port
7 copper alligator clip
8 viewing port
9 ignition wire feedthroughs

**Figure 1 — Typical test chamber with specimen mounted in specimen holder**

Dimensions in millimetres




**a) Specimen** **b) Promoter**

**Figure 2 — Test specimen and promoter**

# 7 Test specimens

## 7.1 Materials

The minimum quantities of materials required to perform each test properly are summarized in Table 2. Actual test configurations and material quantities for material forms other than those listed shall be established and approved by the authority having jurisdiction.

**Table 2 — Minimum quantities of materials required for testing at each pressure**

| Form of material | Minimum quantity |
|---|---|
| Standard | 10 rod specimens measuring 305 mm long × 3,2 mm in diameter |
| Typical non-standard | 10 specimens measuring 305 mm long × 3,2 mm × 3,2 mm |

As a minimum, all materials used in testing shall meet or exceed user specifications.

Material characteristics can be significantly compromised by sources of contamination, such as exposure to solvents, cleaning agents, abnormal temperatures, variations in humidity, environmental pollutants, particulates and handling. It is important that exposure of test material(s) to these and other contamination sources be sufficiently controlled to minimize variation in test results.

### 7.2 Receipt

Receive and visually inspect the test material: when received, it shall be accompanied by proper identification and standard specimens shall be in the form of cylindrical rods 3,2 mm in diameter by 305 mm long. Any flaws shall be noted.

### 7.3 Cleaning

Specimens shall have been cleaned and dried to end-use specifications prior to receipt at the test facility. If, however, specimens are received with obvious contamination, clean them. All cleaning methods shall be approved by the test requester prior to use.

### 7.4 Preparation

If required, prepare specimens to the proper dimensions.

If a material cannot be obtained or prepared in the cylindrical form, then a non-standard specimen shall be prepared. A typical non-standard specimen might have a square (as opposed to round) cross-section, with 3,2 mm sides, and be a minimum of 305 mm in length.

Any coatings shall be applied, to the thickness proposed for use, to rods.

### 7.5 Inspection

After preparation and/or cleaning at the test facility, inspect the specimens to ensure that they are of the proper dimensions. Any flaws and any residual contamination shall be noted. If the flaws result from specimen preparation at the test facility, new specimens shall be prepared.

## 8 Procedure

**WARNING — Burning of materials may produce smoke and toxic gases, which can affect the health of operators. The test area shall be cleared of smoke and fumes by suitable means. In addition, the use of oxygen-enriched test gases and high-pressure test systems provides unique hazards which should be appropriately addressed prior to utilizing this test procedure.**

### 8.1 Before testing

Before testing, record all pertinent information (including initial test pressure, specimen identification and pre-test length).

The test system shall be visibly clean, and all measuring devices shall be in proper calibration.

Press the promoter onto the test specimen and wrap the ignitor wire around the promoter. Mount the test specimen firmly in the specimen holder, and connect the ignitor wire to the power supply.

### 8.2 Test

Place the specimen and holder in the test chamber and establish the proper test atmosphere. Record the initial pressure. Activate the ignition source. Immediately the promoter has ignited, turn off the power supply. After the test, record the final pressure and the specimen burn length.

## 9 Accuracy

Measurements shall be made within the following tolerance limits:

a) absolute pressure: ± 1 %;

b) specimen dimensions: ± 5 %;

c) burn length: ± 10 mm.

## 10 Test report

### 10.1 Standard tests

The test report shall include details of the specimen identification, the test conditions and the specimen burn length. The test report (in an acceptable format) shall be submitted to the authority having jurisdiction and/or the test requester.

### 10.2 Non-standard tests

When there is a deviation from the standard test parameters, such as non-standard specimen preparation, orientation, configuration or ignition source, the test shall be identified as non-standard. In addition, all information in 10.1 shall be reported.

## 11 Good laboratory practice

At least every 2 years, the test facility should successfully demonstrate the ability to obtain accurate and repeatable data when testing selected material. The authority having jurisdiction shall choose appropriate GLP materials for its test facilities. The materials selected shall include both flammable and flame-resistant materials.

# Annex A
(informative)

# Competency and accreditation of test facilities

## A.1 Competency

Laboratories should be accredited to perform the flammability and/or combustion test methods contained within this part of ISO 14624. Accreditation is necessary because data from such testing is presented for aerospace flight material selection approval. Accreditation should be based on ISO/IEC 17025 and the specific requirements described in this part of ISO 14624.

The accreditation programme should include proficiency testing and should be consistent with ISO/IEC Guide 43-1.

## A.2 Accreditation

Accreditation is the responsibility of the accreditation body recognized within its jurisdiction to administer laboratory accreditation. An acceptable laboratory accreditation body would be a signatory to the multi-lateral mutual recognition arrangement (MRA) of the International Laboratory Accreditation Cooperation (ILAC)[1)] or a signatory to an ILAC-equivalent regional/national MRA that requires accreditation bodies to conform to ISO/IEC Guide 58.

## A.3 Guidelines

An accredited laboratory should conform to the following guidelines:

a) For required tests, the test facility should have performed the test method at least once during the last eighteen months and participated in comparisons of results with other accredited test facilities (round-robin testing).

b) All instrumentation used in the test should be in proper calibration and bear the appropriate documentation to validate traceability to appropriate national or international measurement standards.

c) The test facility should ensure that all testing is accomplished in accordance with approved test plans and procedures, and that the data records and test results are complete and accurate.

d) Complete test records should be prepared by the test facility for each material tested and the test facility should maintain a permanent record of test data for a minimum of fifteen years for historical purposes.

1) Full information is available at the web site http://www.ilac.org/ of ILAC - International Laboratory Accreditation Cooperation or through the ILAC Secretariat, c/o NATA, 7 Leeds Street, Rhodes NSW 2138, Australia. Tel.: +61 2 9736 8374, Fax: +61 9736 8373, e-mail: ilac@nata.asn.au

# Bibliography

[1] ISO/IEC 17025:1999, *General requirements for the competence of testing and calibration laboratories*

[2] ISO/IEC Guide 43-1:1997, *Proficiency testing by interlaboratory comparisons — Part 1: Development and operation of proficiency testing schemes*

[3] ISO/IEC Guide 58:1993, *Calibration and testing laboratory accreditation systems — General requirements for operation and recognition*

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