
**Space systems — Safety and
compatibility of materials —**

Part 1:

**Determination of upward flammability of
materials**

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Systèmes spatiaux — Sécurité et compatibilité des matériaux —

Partie 1: Détermination de l'inflammabilité verticale des matériaux

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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 14624-1 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.

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Space systems — Safety and compatibility of materials —

Part 1: Determination of upward flammability of materials

1 Scope

This part of ISO 14624 specifies a method for the determination of the flammability of aerospace materials by upward flame propagation. Specifically, this test determines if a material, when exposed to a standard ignition source, will self-extinguish and not transfer burning debris to adjacent materials which can be ignited by such debris.

2 Conformance

The test 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

distance from the bottom of the specimen to the farthest evidence of damage to the test specimen due to flame impingement

NOTE This distance includes areas of partial or complete combustion, charring or embrittlement, but does not include areas which are sooted, stained, warped or discoloured, or areas where the material has shrunk or melted away from the heat.

3.2

burn propagation time

time that elapses from ignition of the specimen until vertical flame propagation stops

3.3

self-extinguishing

phenomenon wherein the burn length of a material does not exceed 150 mm

3.4

thin-film specimen

specimen with a total thickness of less than 0,25 mm

NOTE Fabrics or coatings applied to a substrate are excluded.

3.5

transfer of burning debris

movement of burning particles from a burning specimen to adjacent materials

3.6 worst-case configuration
combination of material thickness, test pressure, oxygen concentration and temperature that make the material most flammable

3.7 worst-case use thickness
material thickness that, for a specific application, makes the material most flammable

EXAMPLE The smallest thickness for use without a substrate or the greatest thickness for use with a substrate.

4 Principle

An ignition source with specific characteristics is applied for a defined period of time to the lower end of a specimen of material oriented vertically in a test chamber or fume hood containing a specific test environment. The maximum post-test burn length for at least three standard-sized specimens is recorded. Materials are considered self-extinguishing, when this test method is used, if the maximum burn length for three standard-sized specimens does not exceed 150 mm. In addition, the ignited specimens shall not transfer burning debris to adjacent materials. Failure of any one specimen constitutes failure of the material in that test environment. Materials shall be tested in the worst-case configuration.

5 Reagents

5.1 Test gases, premixed before exposing the specimen to them and verified for conformity with the specification (including accuracy) for oxygen concentration to within $\pm 0.1\%$.

6 Test system

6.1 Test chamber, large enough so that complete combustion of the specimen can occur with no more than a 5 % relative depletion of oxygen concentration. In addition, the test chamber shall not interfere chemically or physically with the test.

Testing may be conducted in a fume hood if the above conditions can be met.

6.2 Measuring devices, properly calibrated.

6.3 Chemical ignition source, meeting the following specifications under ambient conditions:

- a) energy: 3 000 J;
- b) temperature: $1\,100\text{ °C} \pm 90\text{ °C}$;
- c) burning duration: $25\text{ s} \pm 5\text{ s}$;
- d) maximum visible flame height: $65\text{ mm} \pm 6,5\text{ mm}$.

Annex B provides a procedure for preparing, certifying and storing chemical igniters.

Alternative ignition mechanisms may be utilized if they meet the requirements outlined in a) to d) above.

6.4 Power supply, capable of providing 15 A (RMS), connected to a bare 20 AWG nickel-chromium wire (6.5) to initiate the igniter.

6.5 Bare 20 AWG nickel-chromium wire, with a nominal resistivity of $2,3\ \Omega\cdot\text{m}$ and of sufficient length to wrap three equally spaced turns around the chemical igniter.

6.6 Suitable specimen holder, capable of supporting the specimen in the vertical position.

6.6.1 Standard specimen holder (see Figure 1), allowing 50 mm of the width of the specimen to be exposed and extending over the full length of the specimen.

The bottom of the specimen holder shall be located at least 250 mm from the bottom of the test chamber.

6.6.2 Specimen holder for thin-film specimens, allowing at least 50 mm of the width of the specimen to be exposed and minimizing shrinkage of the test material away from the flame. For large thin-film specimens, the exposed width may be up to 150 mm.

Two types of specimen holder may be used:

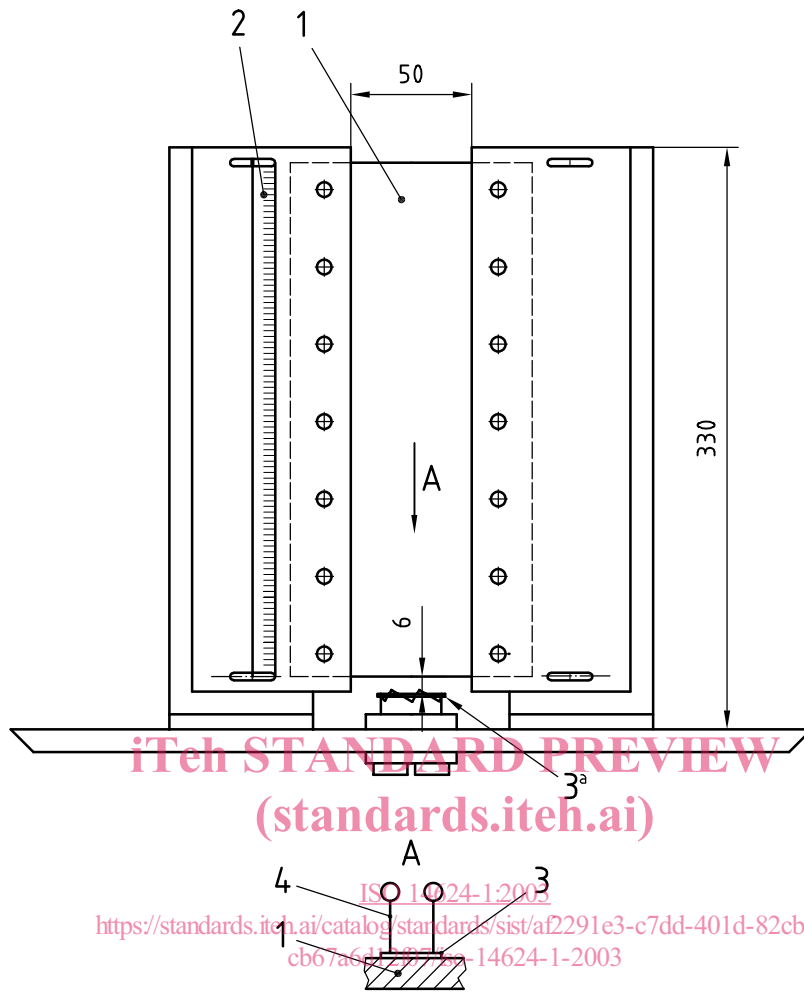
- a) a holder similar to the standard specimen holder (see 6.6.1 and Figure 1), except that it employs three wing-nut clamps instead of one long clamp;
- b) a holder employing needle rakes to hold the specimen (see Figure 2).

6.7 Scale, attached to one side of the specimen holder, for measurement of the burn length.

6.8 Sheet of paper, mounted horizontally approximately 200 mm below the specimen holder, but 50 mm above the bottom of the test chamber, centred directly below the specimen and having the following characteristics:

- a) dimensions: (200 mm ± 50 mm) × (300 mm ± 50 mm);
- b) surface density: between 200 g/m² and 300 g/m²;
- c) type: chemical wood index;
- d) colour: uniformly white;
- e) condition: clean, free from dirt spots, oil spots and foreign matter (lint, fuzz, etc.), free from holes, tears, cuts, folds and scuff marks, and containing no splices.

The sheet of paper is used to assess if burning debris from the specimen would cause ignition of adjacent materials.



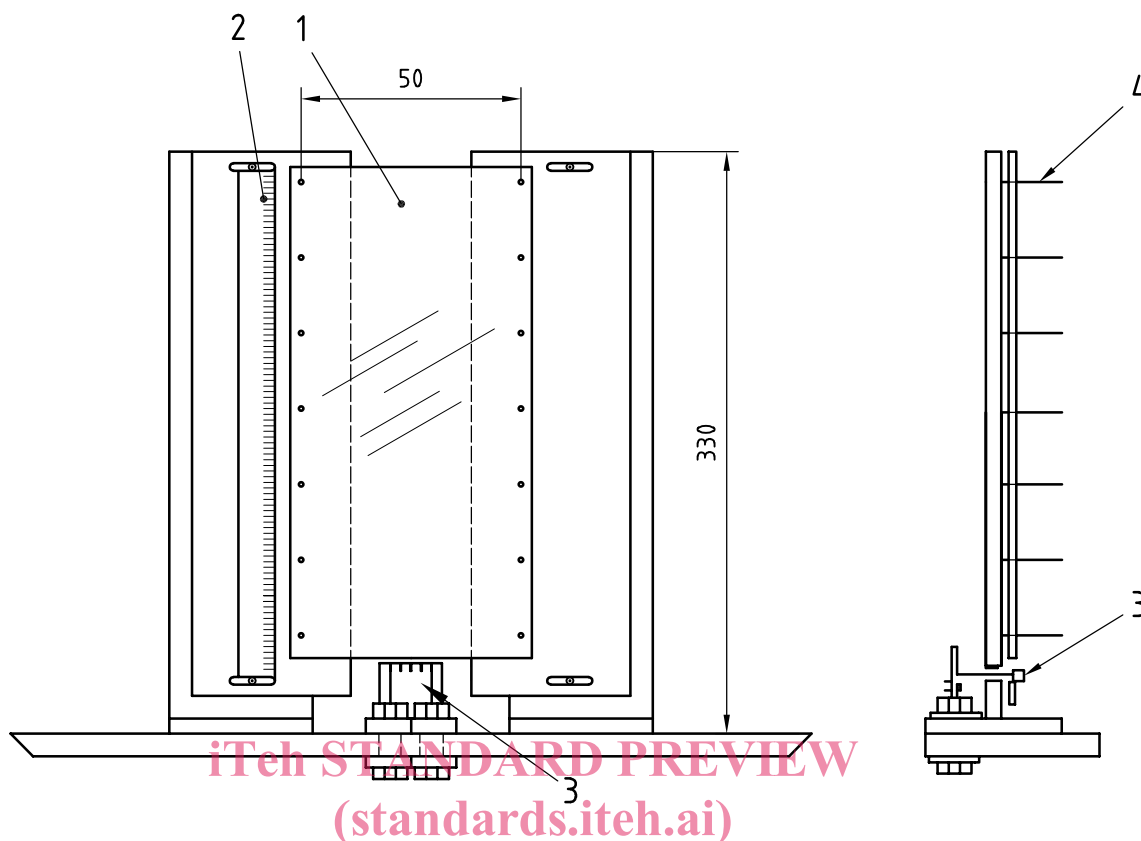
Key

- 1 specimen
- 2 scale
- 3 ignitor
- 4 nickel-chrome wire

^a The ignitor is placed inside the coil.

Figure 1 — Standard specimen holder

Dimensions in millimetres



Key

- 1 specimen
- 2 scale
- 3 ignitor
- 4 needle

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Figure 2 — Needle-rake mount for thin-film specimens

7 Test specimens

7.1 Materials

The minimum quantities of materials required to perform each test properly are summarized in Table 1. Actual test configurations and material quantities for material forms other than those listed (e.g. O-rings and other seals) shall be established and approved by the responsible procuring activity/user materials organization.

Table 1 — Minimum quantities of materials required for testing for each atmosphere

Form of material	Minimum quantity
Sheets	6 specimens measuring 300 mm × 65 mm × the required thickness
Thin films	6 specimens measuring 300 mm × 75 mm × the required thickness When the influence of the test stand on the results is of concern, large thin films measuring 300 mm × 200 mm × the required thickness may optionally be used, subject to the approval of the authority having jurisdiction.
Coatings	Sufficient to cover, at the required thickness, 6 substrates measuring 300 mm × 65 mm
Foams	6 specimens measuring 300 mm × 65 mm × the required thickness
Insulated wires	2 m in length