INTERNATIONAL STANDARD

ISO CD 14624-7

Committee Draft

2001-04-01

Space systems ¾ Safety and compatibility of materials – Part 7: Test method for determining the permeability and penetration of materials to aerospace fluids

Systémes spatiaux — *Sécurite et compatibilité des materiaux* – Partie 7: *: Methode d'essai pour determination de la perméabilité et pénétration de matériaux aux liquides aérospatials*

Reference number

ISO CD 14624-7:2001(E)

Contents

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 nongovernmental, 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.

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.

International Standard ISO 14624-7 was prepared by Technical Committee ISO/TC 20, Aircraft and Space Vehicles; Sub-Committee SC 14, Space Systems and Operations.

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

Part 1: Test method for upward flammability of materials

Part 2: Test method for determination of electrical wire insulation and accessory flammability

Part 3: Test method for determination of offgassed products from materials and assembled articles

Part 4: Test method for upward flammability of materials in gaseous oxygen and oxygen-enriched environments

Part 5: Test method for determining the reactivity of system/component materials with aerospace hypergolic propellants

Part 6: Test method for determining the reactivity of processing materials with aerospace fluids

Part 7: Test method for determining the permeability and penetration of materials to aerospace fluids

Introduction

This purpose of this International Standard is to provide procedures to determine the permeability rate and penetration resistance of materials exposed to aerospace fluids.

Space systems ¾ Safety and compatibility of materials – Part 7: Test method for determining the permeability and penetration of materials to aerospace fluids

1 Scope

This International Standard describes test equipment and techniques used to identify interactions resulting from exposure of a material to an aerospace fluid.

This International Standard may be used to determine the reactivity of materials with aerospace fluids. This International Standard provides a means to determine the effects of minor amounts of aerospace fluids, such as in a splash or spill, on materials used in ground support processing operations, and in the selection of personal safety equipment.

2 Normative references

The following normative references contain provisions that, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subjects to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 4599:1986, Plastics - Determination of resistance to environmental stress cracking (ESC) - Bent strip method.

ISO 4954:1993, Steels for cold heading and cold extruding.

ISO 6529:1990, Protective clothing - Protection against liquid chemicals - Determination of resistance of air-impermeable materials to permeation by liquids.

ISO 6530:1990, Protective clothing - Protection against liquid chemicals - Determination of resistance of materials to penetration by liquids.

ISO 14951-3:1999, Space systems – Fluid characteristics – Part 3: Nitrogen.

3 Definitions

For the purposes of this International Standard, the following terms and definitions shall apply:

3.1
aerospace fluids
fluids that are commonly used in the fabrication, development, processing of materials, and production of aerospace and ground support equipment.

EXAMPLE : Cleaning agents, lubricants, and solvents are examples of aerospace processing fluids.

3.2
degradation
an adverse physical or chemical change in a substance

3.3
reaction
a chemical change in which a substance decomposes, combines with other substances, or interchanges constituents with other substances

4 Safety precautions

4.1 Laboratory facilities

Some aerospace fluids are considered to be toxic chemicals. These chemicals shall only be exposed to room atmosphere inside an approved laboratory hood. Separate, dedicated hoods shall be used for the oxidizers and fuels.

4.2 Protective clothing

Personal protective clothing shall be worn by personnel when performing these tests. The minimum protection required are fluid-compatible gloves, laboratory apron, and face shield or goggles.

5 Test procedure

5.1 Sample receiving inspection

When received, the test material must be accompanied by proper identification. The minimum information required is the manufacturer, trade name, composition, specification, generic name, and batch/lot number (if known). A visual inspection shall be performed and any anomalies shall be noted. A suitable sample identification form is shown in Figure 1.

5.2 Sample preparation

5.2.1 General

The sample should be tested in the intended use form (such as sheets or foams) and in the as-received thickness.

5.2.2 Sample cleaning

Samples shall be cleaned and dried to the end-use specifications. Contamination on the surfaces of solid, nonporous samples shall be removed by washing with deionized water and mild detergent, rinsing with deionized water, and drying with filtered, gaseous nitrogen. Particulate on the surfaces of solid, porous samples shall be removed with filtered, gaseous nitrogen meeting the requirements of ISO 14951-3.

5.2.3 Sample inspection

The sample shall be inspected to ensure it is at the specified worst-case thickness. Flaws and any residual contamination shall be noted. If the flaws result from sample preparation at the test facility, new samples shall be prepared. Samples with flaws that inordinately increase the surface area to bulk mass ratios should not be tested. Samples shall be weighed and individually identified.

5.3 Penetration test

5.3.1 General

This test is used to determine the possible liquid penetration of materials when exposed to aerospace fluids or other chemicals of interest.

Table 1 – Sample identification form

Test Material

Manufacturer _____

Trade Name _____

Composition _____

Specification _____

Generic Name _____

Batch / Lot Number _____

Use Temperature (minimum) _____

Use Temperature (maximum) _____

Aerospace Fluid Exposure Time (field use) _____

Manufacturer

Name

Address _____

City _____

State _____

Country _____

Supplier

Name

Address _____

City _____

State _____

Country _____

Remarks _____

_____

_____

5.3.2 Test procedure

The test procedure shall be as follows:

a) Place an appropriately sized sample of the test material (see Figure 2) over a beaker.

b) Add the test fluid, approximately 1 millilitre (mL) of the specified test fluid, to the center of the sample, taking care not to expose the edges of the sample to the fluid, and start the timer.

c) Allow the test fluid to stand on the sample for the specified exposure time.

d) Add test fluid as required to maintain a liquid film on the test sample during the specified exposure time.

e) Carefully observe for the first fallen droplet at the bottom of the beaker, stop the timer, and note the time of occurrence.

f) For materials used for protective garments, observe for initial wetness underneath the test sample and note the time of occurrence.

NOTE: Atmospheric condensation could occasionally form underneath a sample during a test, giving a false indication of penetration. In such an event, verification can be made by applying a hypergol compatible blotter that is known to discolor when in contact with a particular aerospace fluid.

g) Carefully blot the liquid from the sample at the end of the specified exposure time.

h) Rinse the sample with running water for 60 seconds.

i) Allow the test sample to air dry for 24 hours prior to final evaluation.

5.3.3 Report

The report shall consist of the following as a minimum (an example of a suitable form for reporting the results of this test is shown in Figure 3):

a) The name of the test material, supplier, and manufacturer.

b) The test temperature, pressure, duration, and sample thickness before and after the test.

c) Any penetration observed during the exposure and the elapsed time of occurrence.

d) For materials used for protective garments, any wetness observed underneath the test sample during the exposure and the elapsed time of occurrence.

e) Any reactivity observed during the exposure such as burning, smoking, bubbling, frothing, charring, solubility, swelling, or fracture of the sample.

f) Any changes in the condition of the sample after the exposure such as color, flexibility, rigidity, surface condition, transparency, pitting, hardness, tackiness, friability, or powder formation.

5.4 Permeability test

5.4.1 General

This test is used to determine the vapor or liquid permeation rate of a material when exposed to aerospace fluids or other chemicals of interest as specified by the requester.

Two kinds of permeability tests may be performed: conditioned and/or unconditioned. The conditioned test is performed on specimens that were previously exposed to the test fluid prior to a permeability test in order to simulate used materials. The unconditioned test is performed on new, unused specimens in the as-received condition. Unless otherwise specified, the duration of the permeability test shall be 120 minutes.

5.4.2 Configuration requirements

The permeability tests shall be performed in accordance with ISO 6529 or ISO 6530, or other approved test methods as appropriate. Materials used for enclosed, pressurized, protective garments shall always be tested with the pressure on the collection side of the test cell maintained between 10 millimetres (mm) and 20 mm of water above the

pressure applied on the test fluid side of the cell. If conditioned test specimens are used, the conditioned side shall be facing the test fluid side of the cell.

5.4.3 Preparation of conditioned test samples

The preparation shall be as follows:

a) Place the test specimen (Figure 2) on a flat stainless steel or polytetrafluoroethylene base plate (see Figure 4). The side of the material that is normally exposed in service shall be in the up position. The stainless steel base plate shall meet the requirements of ISO 4954.

b) Apply a bead of fluid-compatible grease to a template (see Figure 4) around the opening (to prevent wicking under the template).

c) Clamp the template (with the grease against the test specimen) and test specimen to the base plate. The test specimen shall be sandwiched between the template and the base plate.

d) Place sufficient test fluid on the specimen to wet the entire surface.

e) Allow the test fluid to stand on the test specimen for 60 seconds.

f) Carefully remove the test fluid, rinse the test specimen with deionized water for 60 seconds, and disassemble the test fixture.

g) Wipe the grease off the test specimen taking care not to contaminate the propellant exposed area of the test specimen.

h) Allow the test specimen to air dry for 24 hours.

I) Perform this process with the same sample using, in order, monomethylhydrazine, nitrogen tetroxide, and hydrazine.

j) Condition the test specimen a second time.

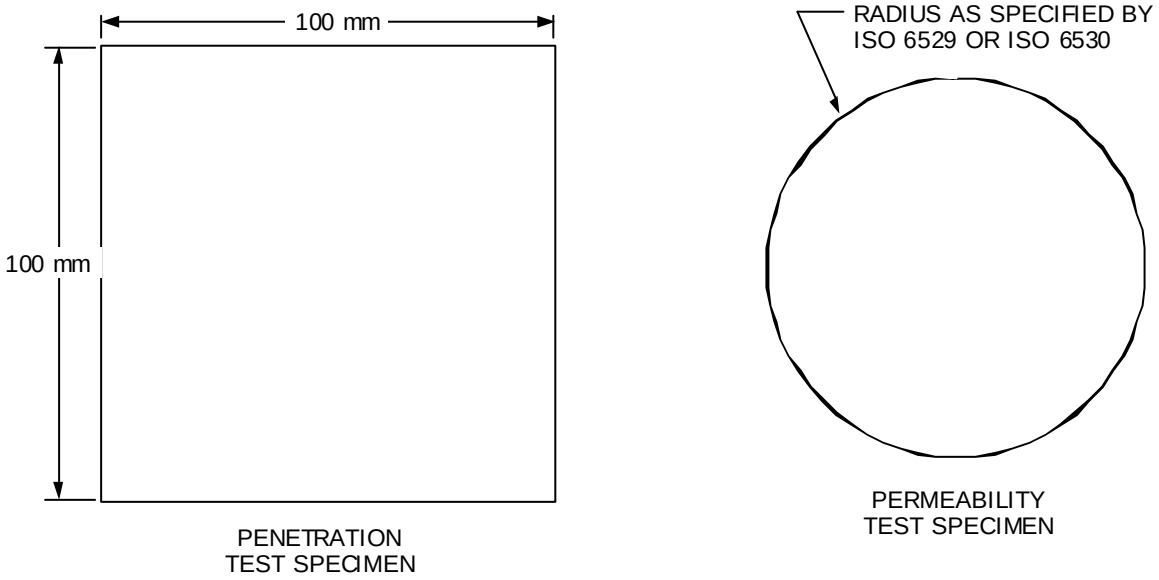

Figure 1 – Test specimen (millimetres)

PENETRATION TEST REPORT FORM

		Date	Sample Number
Requesting Organization	Requestor	Telephone No.	Reference Document
Vehicle	System		
Material Name or Manufacturer's ID		Special Instructions	
Chemical Class of Material			
Generic Name of Material			

TEST CONDITIONS

Test 1 Sample per: _____
Test Name: _____
Test Fluid: _____

TEST DATA

Test Sample Description: _____
Material Quantity (gms): _____ Container Volume (mL): _____
Media Volume (ml): _____ Media Exposure Time (Hr): _____

OBSERVATIONS

Burn _____ Temp. Change _____
Smoke _____ Soluble _____
Froth _____ Fracture _____
Bubble _____ Swell _____
Char _____
Remarks: _____

VISUAL CHARACTERISTICS

	Pretest	Posttest
Color		
Opaque		
Translucent		
Transparent		

Remarks: _____

BULK CHARACTERISTICS

	Pretest	Posttest
Shape		
Flexible		
Rigid		
Soft		
Hard		
Friable		
Powder		

Remarks: _____

SURFACE CHARACTERISTICS

	Pretest	Posttest
Smooth		
Rough		
Wrinkled		
Pitted		
Woven		
Matted		
Tacky		

Remarks: _____

Other Observations

Conclusions

☐ No Penetration Observed
☐ Slight to Moderate Penetration Observed
☐ Sample Shows Indications of Gross Incompatibility

Analyst:	Date:	Approval:

Figure 2 – Penetration test report form

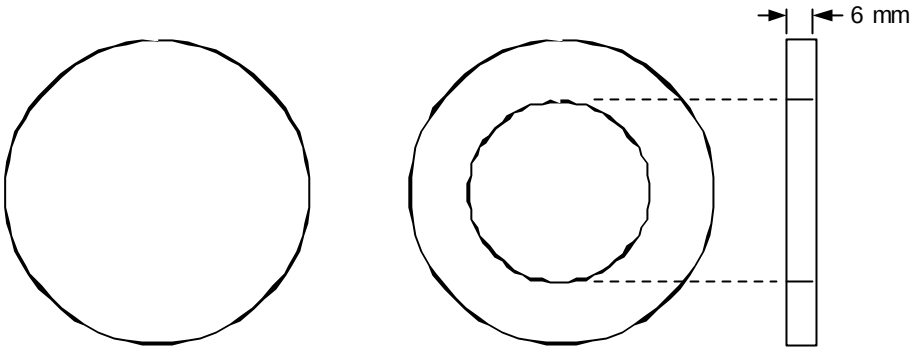

Figure 3 – Conditioning fixture for permeability test

5.4.4 Test procedure for oxidizer permeability

5.4.4.1 General

Test method ISO 6529 or ISO 6530 shall be used as appropriate. The test cell shall be compatible with the oxidizer. This test shall be conducted with the test cell oriented such that the test specimen is in contact with the gas phase only.

The test procedure shall be as follows:

a) Fill the assembled test cell approximately half full with liquid oxidizer.

b) Allow the oxidizer vapors to vent freely for approximately 60 seconds, then seal the test cell.

c) After 120 minutes, open the seals and drain the oxidizer from the test cell.

d) Disassemble the test cell.

e) Decontaminate the test specimen by gently blotting any liquid from the sample and rinsing it with running water for 60 seconds.

f) Allow the test sample to air dry for 24 hours.

5.4.4.2 Report

The report shall consist of the following as a miimum (an example of a suitable form for reporting the results of this test is shown in Figure 5):

a) The name of the test material, supplier, and manufacturer.

b) The test method used.

c) The test temperature, pressure, duration, and sample thickness before and after the test.

d) Any differential pressure maintained across the test specimen.

e) The condition of the test specimen at the conclusion of the test.

f) The breakthrough time (minutes).

g) The steady state permeability rate (µg/mm^2/min).

h) The threshold detection level of the measuring system to the specific oxidizer used in the test.

5.4.5 Test procedure for aerospace fluid permeability

Test method ISO 6529, ISO 6530, or other suitable test method may be used as appropriate. The test cell shall be compatible with the test fluid. This test shall be conducted as in 5.4.4.1 except that the test cell is oriented such that the test specimen is in contact with the liquid phase only.

5.4.6 Report

The report shall consist of the following as a minimum (an example of a suitable form for reporting the results of this test is shown in Figure 4):

a) The name of the test material, supplier, and manufacturer.

b) The test method used.

c) The test temperature, pressure, duration, and sample thickness before and after the test.

d) Any differential pressure maintained across the test specimen

e) The condition of the test specimen at the conclusion of the test.

f) The breakthrough time (minutes).

g) The steady state permeability rate (µg/mm^2/min).

h) The threshold detection level of the measuring system to the specific test fluid used in the test.

PERMEABILITY TEST REPORT FORM

Date | Sample Number

Requesting Organization | Requestor | Telephone No. | Reference Document

Vehicle | System

Material Name or Manufacturer's ID

Chemical Class of Material

Generic Name of Material

Special Instructions

TEST CONDITIONS

Test 1 Sample per: _____

Test Name: _____

Test Fluid: _____

TEST DATA

Test Sample Description: _____

Material Quantity (gms): _____

Media Volume (ml): _____

Breakthrough Time (Minutes) _____

Steady State Permeability Rate (µg/mm^2/min) _____

Remarks: _____

Container Volume (mL): _____

Media Exposure Time (Hr): _____

VISUAL CHARACTERISTICS	Pretest	Posttest
Color		
Opaque		
Translucent		
Transparent		

Remarks: _____

BULK CHARACTERISTICS	Pretest	Posttest
Shape		
Flexible		
Rigid		
Soft		
Hard		
Friable		
Powder		

Remarks: _____

SURFACE CHARACTERISTICS	Pretest	Posttest
Smooth		
Rough		
Wrinkled		
Pitted		
Woven		
Matted		
Tacky		

Remarks: _____

Other Observations

Analyst: | Date: | Approval:

Figure 4 – Permeability test report form

Bibliography

ASTM F739, Standard Test Method for Resistance of Protective Clothing Materials to Permeation by Liquids or Gases Under Conditions of Continuous Contact

ISO 14951-5:1999, Space systems – Fluid characteristics – Part 5: Nitrogen tetroxide propellant.

ISO 14951-6:1999, Space systems – Fluids characteristics – Part 6: Monomethylhydrazine propellant.

ISO 14951-7:1999, Space systems – Fluid characteristics – Part 7: Hydrazine propellant

ISO 14951-10:1999, Space systems – Fluid characteristics – Part 10: Water.