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Space systems — Safety and compatibility of materials —

Part 5: Determination of reactivity of system/ component materials with aerospace propellants

*Systèmes spatiaux — Sécurité et compatibilité des matériaux —
Partie 5: Détermination de la réactivité des matériaux des systèmes/
composants avec les ergols spatiaux*

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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

This second edition cancels and replaces the first edition (ISO 14624-5:2006), which has been technically revised.

The main changes are as follows:

- updated sections of [Clause 4](#).

A list of all parts in the ISO 14624 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This purpose of this document is to identify changes resulting from exposure of a material to an aerospace fluid that renders either the material or the fluid unsuitable for use.

This document can be used to determine the reactivity of system and component materials with aerospace fluids.

While this procedure is an excellent quick screen test for long-term propellant compatibility, it is semi-qualitative, and (if exposures exceed 12 months) long-term tests need to be used to quantify degradation as a function of time under use conditions.

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Space systems — Safety and compatibility of materials —

Part 5:

Determination of reactivity of system/component materials with aerospace propellants

1 Scope

This document specifies test equipment and techniques used to identify interactions resulting from exposure of a material to an aerospace fluid.

It is applicable for determining interactive reactions between propellants and materials used in the design, construction, and operation of propellant storage, transfer, and flight systems.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 4954, *Steels for cold heading and cold extruding*

ISO 15859-3, *Space systems — Fluid characteristics, sampling and test methods — Part 3: Nitrogen*

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

degradation

adverse physical or chemical change in a substance

3.2

immersion test

test in which the fluid covers the entire sample for the duration of the test

3.3

propellant

fluid, such as hydrazine and monomethylhydrazine, and oxidizer usually used for space projects

3.4

reaction

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

4 Fluid transfer, storage and flight systems

4.1 General

4.1.1 Procedure

This procedure is applicable for determining interactive reactions between propellants and materials used in the design, construction, and operation of propellant storage, transfer, and flight systems. The sample is immersed in the test fluid for 48 h at the maximum system temperature or 71 °C, whichever is higher. This accelerated test provides semi-qualitative information. Tests used to evaluate the long-term interaction of materials with reactive fluids shall be conducted for a period of time no less than that of the anticipated time of use.

4.1.2 Safety

The proper safety equipment shall be worn by the technician performing the test. A face shield, gloves and a laboratory coat or apron shall be worn when handling the test fluids.

Test fluids shall be handled by engineering controls (e.g. operational fume hood) or as directed by the appropriate safety data sheets for the test fluids.

The laboratory conducting the tests shall have a detailed emergency plan in the event of a runaway reaction.

4.2 Test criteria

4.2.1 Screening test

Exposure of the material (screening test) to the fluid for 2 h at ambient temperature and pressure shall not visibly change either the material or the fluid.

4.2.2 Immersion test

The standard test temperature for the hydrazine propellants (see ISO 14951-6^[1] and ISO 14951-7^[2]) is (71 ± 3) °C. This temperature shall be used when the intent of the test is ranking of materials or comparison to literature information. Other temperatures may be used to test materials for specific applications. For fluids that do not decompose into gaseous products at the test temperature (e.g. nitrogen tetroxide), the pressure increase shall not be greater than the vapour pressure of the fluid after exposure to polytetrafluoroethylene (for non-metals) or ISO 4954 stainless steel (for metals).

4.2.3 Post-test analysis

After the sample has been exposed, decontaminated and dried, no visible change in colour or texture of the material or test fluid shall be apparent. In addition, the sample mass change shall not be greater than ± 2 %.

The following also applies:

- a) the mass of impurities in the fluid after exposure to the material shall not be greater than twice the mass of impurities in the identical fluid after exposure to polytetrafluoroethylene (for non-metals) or ISO 4954 stainless steel (for metals);
- b) halide (F^- , Cl^- , Br^-) concentrations in the fluid after exposure to the material shall not exceed the appropriate ISO specification for the fluid purity.

1) Withdrawn.

2) Withdrawn.

4.3 Sample

4.3.1 Receiving inspection

When received, the test material shall 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 material identification form is shown in [Annex A](#).

4.3.2 Sample preparation

The sample shall be tested in the intended use form (such as sheets or foams) and in the as-received thickness. Samples for the screening test shall weigh $\leq 0,25$ g. Samples for the immersion test shall have a surface area of (25 ± 10) cm².

4.3.3 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 de-ionized water and mild detergent, rinsing with de-ionized 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 15859-3.

4.3.4 Sample inspection

The cleaned 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 shall not be tested. Samples shall be weighed and individually identified.

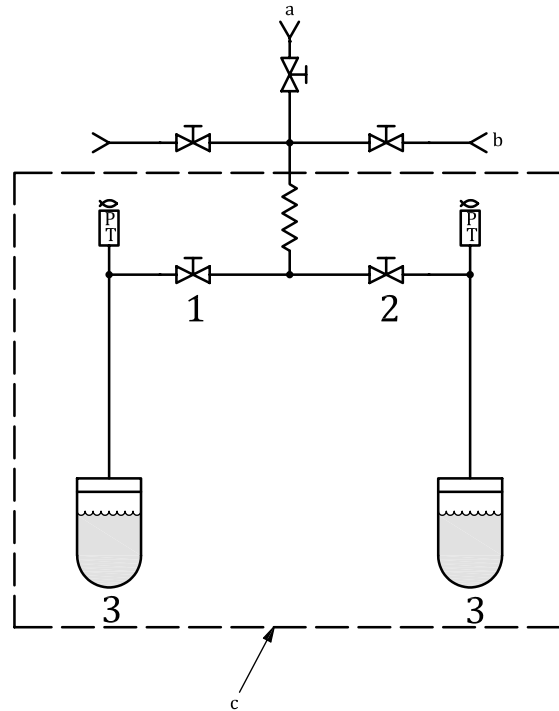
4.4 Test system

4.4.1 Screening test

The test system for the screening test shall consist of a glass beaker.

4.4.2 Immersion test

The test system for the immersion test shall consist of one reference and one sample chamber and temperature- and pressure-measuring devices (see [Figure 1](#)). Differential pressure transducers may be used for fluids, such as hydrazine and monomethylhydrazine, that decompose into gases at the test temperature. Absolute pressure transducers (on the sample and reference sides of the test system) may be used for those fluids that do not decompose into gases or undergo wide pressure fluctuations. Recommended analytical instruments for the post-test analyses include a differential scanning calorimeter, gas chromatography, gas chromatography/mass spectrograph, atomic absorption spectrophotometer, inductively coupled plasma optical spectrometer, inductively coupled plasma/mass spectrometer, ion chromatography, and high-performance liquid chromatography.



Key

- 1 solution valve 1
- 2 solution valve 2
- 3 test sample
- a Vent to hood.
- b Gaseous nitrogen source.
- c Heated volume.

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Figure 1 — Immersion test system

4.5 Procedure

4.5.1 Before testing

The test system shall be clean, and all measuring devices shall be in current calibration. The pretest procedure shall be as follows.

- a) Analyse the fluid to be used in testing for impurities.
- b) Verify the fluid meets the required use specifications before being exposed to the samples.
- c) Record all pertinent information for the test, such as sample identification and pretest information about the sample and fluid.
- d) Clean and dry the test and reference samples.
- e) Photograph the samples.