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Space systems — Safety and compatibility of materials —

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

Systèmes spatiaux — Sécurité et compatibilité des matériaux — Partie 3: Détermination des produits issus du dégazage sous atmosphère des matériaux et des articles assemblés

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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 14624-3 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 system/component materials with aerospace propellants*

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

— *Part 7: Determination of permeability rate and penetration resistance 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.

The data obtained from this test are used for a toxicological assessment of the risks to personnel. Additional information can be gathered utilizing this test method, for example, taking samples at equal intervals can provide information on offgassing rates.

Space systems — Safety and compatibility of materials —

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

1 Scope

This part of ISO 14624 specifies a method for determining the identity and quantity of volatile offgassed products from materials and assembled articles utilized in manned, pressurized spacecraft. This test method is not intended to model or simulate spacecraft atmospheres.

2 Conformance

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

The authority having jurisdiction, or 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). Materials also shall be accompanied by the appropriate vendor-supplied Material Safety Data Sheets to comply with materials-handling requirements defined by the appropriate country's Occupational Safety and/or Health Administration. Materials and configured system characteristics can be significantly compromised by sources of contamination, such as exposure to solvents, cleaning agents, abnormal temperatures, variations in humidity, environmental pollutants, particulate, and handling. It is important that exposure of the material to these and other contamination sources be sufficiently controlled to minimize variation in test results.

As a minimum, all fluids used for testing shall meet or exceed user specifications.

3 Terms and definitions

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

3.1
assembled article
any component or assembly of components that is not a single material

3.2
offgassed product
organic or inorganic compound evolved as a gas from a material or assembled article

3.3
offgassing
evolution of gaseous products from a liquid or solid material into an atmosphere

3.4
spacecraft maximum allowable concentration
SMAC
maximum concentration of an offgassed product that is allowed in the habitable area of the spacecraft for a specified flight duration

NOTE SMAC values for manned spacecraft are determined by the cognizant procuring authority/user toxicologist. A current listing of SMAC values is maintained on the Internet at http://www.jsc.nasa.gov/toxicology/Guidelines.

3.5
toxic hazard index
T
dimensionless ratio of the projected concentration of each offgassed product to its SMAC value and summing the ratios for all offgassed products without separation into toxicological categories, and the calculation of the T value is as follows:

$$T_{\text{total}} = C_1/I_{\text{SMAC1}} + C_2/I_{\text{SMAC2}} + \ldots + C_n/I_{\text{SMAC}_n} \quad (1)$$

where

$C_1, C_2, \ldots, C_n$ are the concentrations of contaminants 1, 2 and n, respectively;

$I_{\text{SMAC1}}, I_{\text{SMAC2}}, \ldots, I_{\text{SMAC}_n}$ are the SMAC values for contaminants 1, 2 and n, respectively

NOTE For assembled articles, concentration is calculated by dividing the total quantity of each contaminant offgassed during a test by the habitable volume of the spacecraft. For materials, the concentration is calculated by multiplying the total quantity of each contaminant offgassed per gram of material by the total mass of the material to be used in the spacecraft.

EXAMPLE Evaluating the maximum limit mass for a standard shuttle test, the total mass of material to be used is assumed to be 45 kg and the habitable volume of the spacecraft is 65 m^3.

3.6
good laboratory practice
GLP
practice that involves the testing of standard materials to verify data accuracy and repeatability

3.7
round robin testing
testing of identical materials at different test facilities for the comparison of results

3.8
average percent relative standard deviation
quotient of the standard deviations for each offgassed constituent of y replicate samples of a standard material and the total number of offgassed constituents

NOTE For actual samples, the expected test results and average relative standard deviations for the quantities of offgassed products are near 50 %. The calculations for standard deviation and average percent relative standard deviation are as follows:

The standard deviation, s, is given by:

$$s = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}}$$

where $\bar{x}$ is the mean for an individual offgassed constituent.

Therefore, the calculation for the average percent relative standard deviation A_s, is given by:

$$A_s = \frac{\sum s}{y} \times 100\ \%$$

where

$\sum s$ is the summation of the standard deviations for each offgassed constituent;

y is the total number of offgassed constituents, for a standard material.

3.9
test chamber
apparatus into which the sample container is placed during thermal conditioning

3.10
sample container
vessel which contains the test sample

3.11
room temperature
room temperature is equal to (23 ± 3) °C

4 Principle

When this method is utilized for a toxicological assessment for a component or a material, the total toxic hazard index (T) values for all volatile offgassed products shall be less than 0,5.

5 Health and safety of test operators

Testing outlined in this part of ISO 14624 may generate toxic substances in either the gas or condensed phase. Care shall be taken to protect test operators from such substances.

6 Test conditions

6.1 The test atmosphere should be at least a volume fraction of (20,9 ± 2) % for oxygen with the balance nitrogen or argon, and the test pressure should be < 15 kPa of the ambient pressure of the test facility. The maximum volume fraction limits [expressed as a volume fraction in µl/l[1)]] for impurities in the compressed gases are:

— carbon monoxide 1;

— carbon dioxide 3,0;

— total hydrocarbons, as methane 0,1;

— halogenated compounds 0,5;

— water 7,0.

6.2 The sample shall be subject to a thermal exposure for (72 ± 1) h at (50 ± 3) °C. Samples tested at one oxygen concentration do not have to be retested at a different oxygen concentration.

1) 1 µl/l = 1 ppm. The use of “ppm” is deprecated.