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Space systems — Surface cleanliness of fluid systems —

Part 5: Drying processes

Systèmes spatiaux — Propreté des surfaces en contact avec des fluides —

Partie 5: Procédés de séchage

Reference number
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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.

ISO 14952-5 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

ISO 14952 consists of the following parts, under the general title *Space systems — Surface cleanliness of fluid systems*:

— *Part 1: Vocabulary*

— *Part 2: Cleanliness levels*

— *Part 3: Analytical procedures for the determination of nonvolatile residues and particulate contamination*

— *Part 4: Rough-cleaning processes*

— *Part 5: Drying processes*

— *Part 6: Precision-cleaning processes*

Introduction

This part of ISO 14952 describes a method for vacuum drying intricate parts or components that are likely to retain entrapped moisture when dried by normal purging techniques. The purpose of this part of ISO 14952 is to provide processes that can be used to ensure the dryness of parts or components subjected to solvent-based or water-based cleaning processes.

Space systems — Surface cleanliness of fluid systems —

Part 5: Drying processes

1 Scope

This part of ISO 14952 provides guidance related to processes used to dry parts and components that have been subjected to solvent-based or water-based cleaning processes, and identifies drying processes that can be used for equipment that has been cleaned for use in ground support equipment, launch vehicles and spacecraft. Vacuum drying can be used to remove entrapped fluids from intricate parts when normal purging methods have been found to be ineffective.

2 Normative references

The following referenced documents are indispensable for the application 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 14951-3:1999, *Space systems — Fluid characteristics — Part 3: Nitrogen*

ISO 14952-1:2003, *Space systems — Surface cleanliness of fluid systems — Part 1: Vocabulary*

3 Terms and definitions

For the purposes of this part of this document, the terms and definitions given in ISO 14952-1 apply.

4 Drying and testing procedure

Components shall be thoroughly dried to remove residual cleaning, rinsing and/or verification media. Effluent gas shall not exhibit an increase in moisture content greater than 5 µl/l or a measurable increase in concentration of residual organic solvents. Items that do not lend themselves to this type of drying or testing procedure (i.e. special surface treatments or coatings) shall be dried in accordance with procedures agreed upon between the cleaning contractor and the customer.

5 Vacuum drying procedure

5.1 Apparatus and reagents

The following items are required to accomplish the vacuum drying processes specified by this part of ISO 14952.

5.1.1 Vacuum oven, with temperature control range from 45 °C to 125 °C.

5.1.2 Purge (test) gas, nitrogen in accordance with ISO 14951-3, Type A.

5.1.3 Thermocouple, for independent temperature monitoring of parts.

5.2 Heating of parts

Component parts shall be placed in the vacuum oven with the thermocouple attached to the largest part placed in the oven. The oven shall be closed and purged with inert test gas, then the oven shall be heated to the desired vacuum drying temperature. The temperature of the parts shall be governed by the following criteria:

a) minimum drying temperature for all parts shall be 45 °C;

b) maximum drying temperature for parts containing nonmetallics shall be 65 °C;

c) maximum temperature for drying metallic parts shall be 125 °C.

5.3 Thermal vacuum drying time

Once the thermocouple monitor indicates that the parts have reached the desired temperature, a vacuum should be drawn on the parts and maintained for the period specified in Table 1. Once the parts have been dehydrated, the heat should be discontinued and the oven slowly back-filled with the test gas.

Table 1 — Vacuum drying time

Values in hours

Vacuum oven pressure kPa	Temperature				
	45 °C	**5 °C**	**6 °C**	**7 °C**	**8 °C**
20,0	—	—	—	0,9	0,75
15,0	—	—	1,3	0,8	0,75
13,0	—	4,8	1,2	0,75	0,75
9,5	—	2,0	0,8	0,75	0,75
6,5	3,4	1,1	0,75	0,75	0,75
3,0	0,9	0,75	0,75	0,75	0,75
2,0	0,75	0,75	0,75	0,75	0,75

6 Gaseous purge-drying procedure

6.1 Materials

Gases used in purge-drying processes shall conform to the following requirements.

a) Nitrogen, filtered to remove particulates greater than 5 µm, shall be in accordance with Type A of ISO 14951-3:1999.

b) Air shall contain no particulate matter greater than 5 µm. The hydrocarbon content shall not exceed 10 µl/l except that a total value of 20 µl/l is acceptable when the portion of the total hydrocarbon content representing compounds containing 5 or more carbon atoms does not exceed 5 µl/l. The relative humidity shall not exceed 60 %.

6.2 Drying sample

6.2.1 Reliability sample

The quantitative analysis reliability sample shall consist of a minimum of 5 % of the items dried but not less than one sample from each group of items dried. The sample shall be selected in a manner that will provide maximum representation of the lot containing production items that have been cleaned, verified and dried. A lot does not necessarily mean identical parts but does include all hardware processed in one operation. The reliability sample and the segment of production that it represents shall be clearly identified, as specified by the customer.

6.2.2 Procedure reliability

Alternatively, the reliability of the drying procedure may be established for each hardware configuration and drying process. After qualification of the procedure and equipment for a specific hardware configuration, reliability sampling shall be left to the discretion of the customer. Samples for qualification of the drying process shall be selected as follows.

a) Select a minimum of five cleaned, verified and dried items from each of the hardware configuration to be qualified.

b) Evaluate samples in accordance with 6.3.

c) Upon qualification of the drying procedure for each hardware configuration, the established drying cycle requirements shall be implemented. Periodic spot tests shall be made to ensure that drying procedures continue to be effective.

6.3 Drying test

Unless otherwise approved by the customer, the reliability of the drying procedure for items subjected to liquids during cleaning or drying procedures shall be determined as follows.

a) Prefiltered drying gas shall be flowed through or over the affected surfaces of the item being tested.

b) For hardware processed with aqueous media, the dewpoint of the drying gas entering and leaving the affected item shall be monitored to determine the presence of moisture on cleaned and dried surfaces. An increase in the moisture content of the drying gas of 5 µl/l or greater shall necessitate additional drying prior to packaging or the application of protective coverings.

c) For hardware processed with halogenated solvents, the effluent drying gas shall be monitored with a halogen detector to determine if affected surfaces are free from residual solvent. If no measurable concentrations are indicated by the halogen detector, the affected surfaces shall be considered free from residual halogenated solvents. Any measurable concentration above ambient in the drying gas shall necessitate additional drying prior to packaging or application of protective coverings.

For hardware processed with alcohols or other hydrocarbons, the effluent drying gas shall be monitored with a hydrocarbon detector. Any measurable concentration above ambient in the drying gas shall necessitate additional drying prior to packaging or application of protective coverings.

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