INTERNATIONAL STANDARD

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Space systems — Surface cleanliness of fluid systems —

Part 2: Cleanliness levels

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

Partie 2: Classes de propreté

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Foreword

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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 14952-2 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 defines the cleanliness levels intended for use in cleaning processes for equipment and components used in space fluid systems. The purpose of this part of ISO 14952 is to establish uniform cleanliness levels for use in the cleaning, analysis, and verification processes for launch vehicles, spacecraft and ground support equipment.

Space systems — Surface cleanliness of fluid systems —

Part 2:
Cleanliness levels

1 Scope

This part of ISO 14952 defines the cleanliness levels used in the cleaning, analysis, and verification procedures for space fluid systems. It establishes a common nomenclature for use in describing cleanliness levels for equipment used in ground support equipment, launch vehicles and spacecraft.

This part of ISO 14952 is used to specify the cleanliness level of fluid system components and equipment used in space systems. It is applicable equally to ground support equipment, launch vehicles and spacecraft.

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

ISO 14952-3:2003, *Space systems — Surface cleanliness of fluid systems — Part 3: Analytical procedures for the determination of nonvolatile residues and particulate contamination*

3 Terms and definitions

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

4 Classification

4.1 General

Particle cleanliness levels are listed in Table 1, nonvolatile residue (NVR) contamination levels are listed in Table 2, and visible contamination levels are listed in Table 3. Particle cleanliness is based on particle counting using aided or unaided eye analysis, NVR analysis is based on fluid solvent analysis, and the contamination levels are typically obtained by chemical analysis. Annex A gives the background for these tables.

4.2 Code usage

After the desired level of cleanliness is decided, the appropriate code for that level shall be derived from the appropriate table or tables, as needed. This code shall be used to specify to the cleaning facility the desired level of cleanliness. After cleaning, analysis and verification are completed by the cleaning facility, the cleaned part or component shall be sealed in a package and marked with the cleaning code attached to the package.

Product cleanliness levels shall be determined by program and system requirements specified as in the following examples.

a) Level 200 refers to limits on particulate matter contamination only.

b) Level 200B refers to limits on particulate matter and nonvolatile residue (NVR) contamination.

c) Level B refers to limits on NVR only.

d) Level 200A is a more stringent cleaning level than level 300B for both particulate matter and NVR.

e) A component cleaned to a more stringent cleanliness level than is required for a system application may be used in the system application (e.g. a component cleaned to level 200A may be used in a system application requiring cleanliness level 250A or some less stringent cleanliness level).

5 Test methods

Cleanliness level test methods shall be as follows.

Method	Description
I	Liquid flush test for particle population and NVR remaining on critical surfaces of items normally cleaned in a controlled environment (applicable for small parts, vessels and surface areas)
II	Liquid flow test for monitoring particle population and NVR remaining on critical surfaces of items normally cleaned in the field (applicable to hoses, tubing, subsystems and systems)
III	Gas flow test for moisture remaining on critical surface after cleaning (applicable to vessels, subsystems and systems)
IV	Liquid flow test to evaluate systems capability to deliver fluid that meets specified cleanliness (particle or NVR) requirements (applicable to inservice systems)
V	Gas flow test method to evaluate systems capability to deliver fluid or gases that meet specified cleanliness (particle or NVR) requirements (applicable to inservice systems)
VI	Gas flow test method to evaluate the cleanliness of a pipeline and associated parts after cleaning with a liquid wetted tampon, slug or mole.

Determination of the cleanliness level of a component or system shall be made by using Method I or II unless otherwise specified by the customer. Procedures for Methods I, II, III, IV, V and VI are specified in ISO 14952-3.

Table 1 — Particle cleanliness levels

Cleanliness level	Particle size (µm)	Maximum allowable particle count (per 0,1 m^2)	Maximum allowable particle count (per litre)
1	$X < 1$	a	a
	$X = 1$	1	10
	$1 < X$	0	0
5	$X < 1$	a	a
	$1 \leqslant X < 2$	a	a
	$2 \leqslant X < 5$	1	10
	$5 \leqslant X$	0	0
10	$X < 1$	a	a
	$1 \leqslant X < 2$	1	10
	$2 \leqslant X < 5$	4	40
	$5 \leqslant X < 10$	2	20
	$10 \leqslant X$	0	0
25	$X < 2$	a	a
	$2 \leqslant X < 5$	30	304
	$5 \leqslant X < 15$	19	194
	$15 \leqslant X < 25$	2	24
	$25 \leqslant X$	0	0
50	$X < 5$	a	a
	$5 \leqslant X < 15$	141	1 410
	$15 \leqslant X < 25$	17	174
	$25 \leqslant X < 50$	6	63
	$50 \leqslant X$	0	0
100	$X < 5$	a	a
	$5 \leqslant X < 15$	1 520	1 520
	$15 \leqslant X < 25$	187	1 870
	$25 \leqslant X < 50$	68	677
	$50 \leqslant X < 100$	10	97
	$100 \leqslant X$	0	0
200	$X < 5$	a	a
	$15 \leqslant X < 25$	2 950	29 500
	$25 \leqslant X < 50$	1 070	10 700
	$50 \leqslant X < 100$	154	1 540
	$100 \leqslant X < 200$	15	148
	$200 \leqslant X$	0	0
300	$X < 25$	a	a
	$25 \leqslant X < 50$	6 430	64 300
	$50 \leqslant X < 100$	926	9 260
	$100 \leqslant X < 250$	93	928
	$250 \leqslant X < 300$	1	13
	$300 \leqslant X$	0	0

Table 1 — (*continued*)

Cleanliness level	Particle size (µm)	Maximum allowable particle count (per 0,1 m^2)	Maximum allowable particle count (per litre)
500	$X < 50$	a	a
	$50 \leqslant X < 100$	10 720	107 200
	$100 \leqslant X < 250$	1 075	10 750
	$250 \leqslant X < 500$	25	250
	$500 \leqslant X$	0	0
[a] 750	$X < 50$	a	a
	$50 \leqslant X < 100$	86 890	868 890
	$100 \leqslant X < 250$	8 705	87 050
	$250 \leqslant X < 500$	206	2 060
	$500 \leqslant X < 750$	7	70
	$750 \leqslant X$	0	0
1 000	$X < 100$	a	a
	$100 \leqslant X < 250$	41 635	416 350
	$250 \leqslant X < 500$	980	9 800
	$500 \leqslant X < 750$	34	340
	$750 \leqslant X < 1\,000$	4	40
	$1\,000 \leqslant X$	0	0

NOTE 1 The particles per litre for fluids column is presented for information only. Fluid system cleanliness should be specified and measured as particles per 0,1 m^2. Fluid cleanliness may be presented as particles per litre.

NOTE 2 X is the particle count.

NOTE 3 Cleanliness levels were based on Military Standard MIL-STD-1246C, *Product Cleanliness Levels and Contamination Control Program*, 1994.

[a] No silting allowed.

Table 2 — NVR contamination levels

NVR level	NVR limit surface ($mg/0,1\ m^2$)	NVR limit volume (mg/l)
A/100	0,01 mg	0,1 mg
A/50	0,02 mg	0,2 mg
A/20	0,05 mg	0,5 mg
A/10	0,1 mg	1,0 mg
A/5	0,2 mg	2,0 mg
A/2	0,5 mg	5,0 mg
A	1,0 mg	10 mg
B	2,0 mg	20 mg
C	3,0 mg	30 mg
D	4,0 mg	40 mg
E	5,0 mg	50 mg
F	7,0 mg	70 mg
G	10,0 mg	100 mg
H	15,0 mg	150 mg
J	25,0 mg	250 mg

Table 3 — Visible contamination levels

Level	Definition
GC	Freedom from manufacturing residue, dirt, oil, grease, etc.
VC	Absence of all particulate and nonparticulate matter visible to the normal unaided eye or corrected-vision eye
VU	Visibly clean and inspected with an ultraviolet light wavelength of 320 nm to 380 nm

Annex A
(informative)

Background

Table 1 was derived from a log-log^2 distribution of particles with a slope of 0,926 that was based on a lognormal distribution with the maximum number of particles at the 1 µm size. This lognormal distribution was derived from measurements of precision-cleaned hardware and, therefore, is representative of cleaned products.

Tables 1 and 2 prescribe the cleanliness levels established to provide a uniform set of criteria for specifying product cleanliness in terms of particles or NVR or both. Cleanliness levels in Tables 1 and 2 are specified in terms of maximum amounts per unit area (0,1 m^2) or volume of test fluid (1 litre). Table 3 prescribes the product cleanliness level in terms of visual evaluation. Unless otherwise specified, cleanliness levels are specified in terms of maximum amounts per unit extent (area, volume or mass) such as counts per 0,1 m^2. The use of a particular extent does not imply that the measurements are to be taken over this extent, but rather that the total amount is to be divided by the total extent. In general, higher accuracy is fostered by the measurement of larger extents.

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