
**Space systems — Contamination and
cleanliness control**

Systèmes spatiaux — Contrôle de la contamination et de la propreté

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 15388:2012

<https://standards.iteh.ai/catalog/standards/sist/e23f0080-96e0-464c-aff2-775c384ed9d4/iso-15388-2012>



Reference number
ISO 15388:2012(E)

© ISO 2012

iTeh STANDARD PREVIEW (standards.iteh.ai)

ISO 15388:2012

<https://standards.iteh.ai/catalog/standards/sist/e23f0080-96e0-464c-aff2-775c384ed9d4/iso-15388-2012>



COPYRIGHT PROTECTED DOCUMENT

© ISO 2012

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms, definitions and abbreviated terms	1
3.1 Terms and definitions	1
3.2 Abbreviated terms	7
4 Management	8
4.1 Organization	8
4.2 Cleanliness requirement specification (CRS)	8
4.3 Contamination and cleanliness control plan (CCCP)	8
4.4 Interface control document (ICD)	9
4.5 Project reviews	9
5 Design activities	10
5.1 Identification of sensitive hardware	10
5.2 Nature of contaminants, their profile and their effects	10
5.3 Contamination prediction	10
5.4 Contamination budget	10
5.5 Cleanliness-oriented design	11
5.6 Selection of materials and processes	11
6 Biocontamination	12
6.1 General	12
6.2 Contamination of hardware by microorganisms	12
6.3 Sterile hardware	12
6.4 Habitable space systems	13
6.5 Planetary protection	13
6.6 Sample protection	13
7 Contamination and cleanliness control for ground operations	14
7.1 Training of personnel	14
7.2 Cleanroom selection and cleanliness control	14
7.3 Cleanroom garments	15
7.4 Ground support equipment (GSE)	15
7.5 Monitoring cleanliness of flight hardware and its near surroundings	15
7.6 Packaging, storage and transport	15
7.7 Cleaning of flight hardware	16
Annex A (informative) Material properties — Electronic databases	18
Bibliography	19

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 15388 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 15388:2004), which has been technically revised.

iTeh STANDARD PREVIEW (standards.iteh.ai)

ISO 15388:2012

<https://standards.iteh.ai/catalog/standards/sist/e23f0080-96e0-464c-aff2-775c384ed9d4/iso-15388-2012>

Introduction

This International Standard addresses the preferred programme elements recommended for contamination and cleanliness control of space systems. This International Standard is written in general terms as a baseline for developing and implementing the control programme. It can be cited as a baseline within a statement of work and/or used for assuring proposal precision and contractor performance. The users are responsible for integrating the elements of this document appropriately to their programme needs.

The purpose of contamination and cleanliness control is to prevent the degradation of the performance of space systems due to particulate and molecular contamination (including biocontamination), and to ensure that the mission objectives are achieved.

iTeh STANDARD PREVIEW (standards.iteh.ai)

ISO 15388:2012

<https://standards.iteh.ai/catalog/standards/sist/e23f0080-96e0-464c-aff2-775c384ed9d4/iso-15388-2012>

iTeh STANDARD PREVIEW **(standards.iteh.ai)**

ISO 15388:2012

<https://standards.iteh.ai/catalog/standards/sist/e23f0080-96e0-464c-aff2-775c384ed9d4/iso-15388-2012>

Space systems — Contamination and cleanliness control

1 Scope

This International Standard establishes general requirements for contamination and cleanliness control that are applicable, at all tiers of supply, to the development of space systems, including ground processing facilities, ground support equipment, launch vehicles, spacecraft, payloads, and ground processing and on-orbit operations. It also provides guidelines for the establishment of a contamination and cleanliness control programme.

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 14624-3, *Space systems — Safety and compatibility of materials — Part 3: Determination of offgassed products from materials and assembled articles*

ISO 14644-1, *Cleanrooms and associated controlled environments — Part 1: Classification of air cleanliness by particle concentration*

ISO 14698-1, *Cleanrooms and associated controlled environments — Biocontamination control — Part 1: General principles and methods*

ISO 14698-2, *Cleanrooms and associated controlled environments — Biocontamination control — Part 2: Evaluation and interpretation of biocontamination data*

ISO 14952 (all parts), *Space systems — Surface cleanliness of fluid systems*

ASTM E 595, *Standard Test Method for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment*

ECSS-Q-ST-70-02C, *Space product assurance — Thermal vacuum outgassing test for the screening of space materials*

United Nations Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, Article IX, 10 October 1967

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

3.1.1

bakeout

activity of increasing the temperature of hardware to accelerate its outgassing rates with the intent of reducing the content of molecular contaminants within the hardware

NOTE Bakeout is usually performed in a vacuum environment but may be done in a controlled atmosphere.

3.1.2

bioaerosol

dispersed biological agents (e.g. viable particles, allergens, toxins or biologically active compounds of microbial origin) in a gaseous environment

3.1.3

biocontamination

contamination of materials, devices, individuals, surfaces, liquids, gases or air with viable particles

3.1.4

classification

(airborne particle concentrations) level (or process of specifying or determining the level) of airborne particulate cleanliness, expressed in terms of an ISO Class N, which represents maximum allowable concentrations for the particle size considered

NOTE 1 Concentrations are measured in particles per cubic metre.

NOTE 2 The concentrations are determined as specified in ISO 14644-1.

3.1.5

clean bench

table or bench-top working surface where a filtered airflow is concentrated across the bench top

NOTE These bench tops have an established classification of maximum allowable airborne contaminants.

3.1.6

clean hood

work area with a workbench, overhead dust deflector and sideboards, and a self-contained filtering unit for airflow to the work area

NOTE These hoods have an established classification of maximum allowable airborne contaminants.

3.1.7

cleanliness level

established maximum allowable amount of contamination in a given area or volume, or on a component

NOTE The term may also apply to the predicted or measured extent of contamination.

ISO 15388:2012
<https://standards.iteh.ai/catalog/standards/sist/e23f0080-96e0-464c-aff2-775c384ed9d4/iso-15388-2012>

3.1.8

cleanliness requirement specification

CRS

document that defines and identifies the spacecraft items and the environmental areas which are sensitive to contamination, the acceptable contamination levels at beginning and end of life and the applicable contamination environment

3.1.9

cleanroom

room in which the concentration of airborne particles is controlled, and which is constructed and used in such a manner as to minimize the introduction, generation and retention of particles inside the room, and in which other relevant parameters such as temperature, humidity and pressure are controlled as necessary

3.1.10

cleanroom garments

clothing designed, manufactured and worn specifically to prevent contamination of hardware by personnel working in the cleanroom

NOTE Cleanroom garments include all items worn by personnel, such as coveralls, frocks, gloves, boots, finger cots and beard covers.

3.1.11

clean zone

dedicated space in which the concentration of airborne particles is controlled, and which is constructed and used in such a manner as to minimize the introduction, generation, and retention of particles inside the zone and in which other relevant parameters such as temperature, humidity and pressure are controlled as necessary

NOTE The clean zone may be open or enclosed and may or may not be located within a cleanroom.

3.1.12**collected volatile condensable material****CVCM**

mass that outgasses from a material and subsequently condenses on a collector, expressed as a percentage of the initial specimen mass

3.1.13**contaminant**

unwanted molecular or particulate matter that could affect or degrade the relevant performance or lifetime of the hardware to which it is attached

3.1.14**contaminate**

introduce a contaminant

3.1.15**contamination**

addition of contaminants to materials, fluids or surfaces

3.1.16**contamination and cleanliness control programme**

organized effort to establish and achieve acceptable cleanliness and contamination levels during all phases of the space system project

3.1.17**contamination analysis document**

report of the analyses and results that are used to determine cleanliness requirements and contamination profiles and budgets

3.1.18**contamination and cleanliness control plan****CCCP**

document that describes how to implement a contamination and cleanliness control programme, as either an independent document or a part of the consolidated project plan

3.1.19**contamination budget**

allowable levels of contamination of hardware at each phase of ground and flight operations

3.1.20**contamination profile**

contamination-related conditions in each phase of ground and flight operations

NOTE 1 Conditions include airborne particulate cleanliness classes, pressure, humidity, temperature, number of personnel engaged in operations, cleaning activities, outlines of facilities and so on.

NOTE 2 The contamination profile is part of the CCCP.

3.1.21**cross-contamination**

transfer of contaminants from one surface or component to another

NOTE Transfer can occur by migration along a surface, by physical contact, airborne as an aerosol, or as a gas or molecular matter.

3.1.22**debris**

solid objects with their largest dimension greater than approximately 1 mm (1 000 µm) in size

3.1.23

electrostatic discharge

ESD

electrical breakdown of dielectric or gas or vacuum gaps, and also of surface interface of dissimilar materials, caused by differential charging of parts of dielectric materials and their interfaces

[ISO 11221:2011, 2.10]

3.1.24

fibre

flexible structure having a length-to-width ratio of 10 to 1 or greater

[ISO 14952-1:2003, 2.9]

3.1.25

generally clean

GC

free from manufacturing residue, dirt, oil, grease, processing debris, or other extraneous contamination based on visual examination

NOTE This level does not apply to hardware that is sensitive to contamination.

[ISO 14952-1:2003, 2.12]

3.1.26

ground support equipment

GSE

non-flight systems, equipment or devices necessary to support the operations of transporting, receiving, handling, assembly, inspection, test, checkout, servicing, launch and recovery of a space system at launch, landing or retrieval sites

[ISO 14625:2007, 3.1.5]

iTeh STANDARD PREVIEW
(standards.iteh.ai)
<https://standards.iteh.ai/catalog/standards/sist/e23f0080-96e0-464c-aff2-775c384ed9d4/iso-15388-2012>

3.1.27

ICD

interface control document

specification that describes the characteristics that must be controlled at the boundaries between systems, subsystems and other elements

3.1.28

microorganism

microscopical individual constituted to carry out life functions

NOTE 1 Microorganisms include organisms such as bacteria, protozoa, yeasts, moulds, fungi, algae and organisms that depend upon other life forms for reproduction such as viruses and parasites.

NOTE 2 Multicellular organisms and agglomerations of microorganisms may be visible to the unaided eye.

3.1.29

microscopical

visible only under a microscope

3.1.30

molecular contamination

contamination due to deposition of molecules on surfaces or their presence in gases or liquids

3.1.31

non-volatile residue

NVR

quantity of soluble or suspended residual material and insoluble particulate matter remaining after temperature-controlled evaporation of a filtered, volatile liquid

NOTE Adapted from ISO 14952-1:2003, 2.17.

3.1.32 occupancy states of cleanrooms

3.1.32.1 as-built

condition whereby the installation is complete with all services connected and functioning but with no equipment, materials, or personnel present

3.1.32.2 at-rest

condition whereby the installation is complete with equipment installed, and operating in a manner agreed between the customer and supplier, but with no personnel present

3.1.32.3 operational

condition whereby the installation is functioning in the specified manner, with the specified number of personnel present and working in the manner agreed upon

3.1.33 offgassing

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

NOTE This is a special definition of outgassing (see 3.1.34) for the application described in ISO 14624-3.

3.1.34 outgassing

evolution of gaseous species from a material, usually in a vacuum

NOTE Outgassing also occurs in higher-pressure environments.

3.1.35 particle

unit of solid or liquid matter with observable size

[ISO 14952-1:2003, 2.20]

NOTE See also 3.1.38, particle size.

3.1.36 particle concentration

⟨on surface⟩ number of particles per unit area

3.1.37 particle concentration

⟨by volume⟩ number of particles per unit volume of fluid

3.1.38 particle size

NOTE Various methods for defining size may be used and are dependent upon the measurement technique.

3.1.38.1 particle size

⟨manual method⟩ apparent maximum linear dimension of a particle in the plane of observation as observed with instruments such as optical, electron, or atomic force microscopes

[ISO 14952-1:2003, 2.21.1]