



DPC: 25/30486708 DC

BSI Group Headquarters

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000

Fax: +44 (0)20 8996 7400

www.bsigroup.com

Date: 24 March 2025

Origin: International

Latest date for receipt of comments: 17 May 2025

Project No. 2024/00272

Responsible committee: ACE/68 Space systems and operations

Interested committees:

Title: Draft BS ISO 11227 ISO 11227 Space systems. Test procedures to evaluate spacecraft material ejecta upon hypervelocity impact.

Please notify admin.start@bsigroup.com if you are aware of any keywords that might assist in clarifying or identifying the standard or of the content of this standard:

- i) has any issues related to 3rd party IPR, patent or copyright
- ii) affects other national standard(s)
- iii) requires additional national guidance or information

WARNING: THIS IS A DRAFT AND MUST NOT BE REGARDED OR USED AS A BRITISH STANDARD. THIS DRAFT IS NOT CURRENT BEYOND 17 May 2025

This draft is issued to allow comments from interested parties; all comments will be given consideration prior to publication. No acknowledgement will normally be sent. **See overleaf for information on the submission of comments.**

No copying is allowed, in any form, without prior written permission from BSI except as permitted under the Copyright, Designs and Patent Act 1988 or for circulation within a nominating organization for briefing purposes. Electronic circulation is limited to dissemination by e-mail within such an organization by committee members.

Further copies of this draft may be purchased from BSI Shop <http://shop.bsigroup.com> or from BSI Customer Services, Tel: +44(0) 20 8996 9001 or email cservices@bsigroup.com. British, International and foreign standards are also available from BSI Customer Services.

Information on the co-operating organizations represented on the committees referenced above may be obtained from <https://standardsdevelopment.bsigroup.com/>.

E-mail: admin.start@bsigroup.com

Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
------------------	------------------------

1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



DRAFT International Standard

ISO/DIS 11227

Space systems — Test procedures to evaluate spacecraft material ejecta upon hypervelocity impact

ICS: 49.140

ISO/TC 20/SC 14

Secretariat: **ANSI**

Voting begins on:
2025-03-24

Voting terminates on:
2025-06-16

This document is circulated as received from the committee secretariat.

THIS DOCUMENT IS A DRAFT CIRCULATED FOR COMMENTS AND APPROVAL. IT IS THEREFORE SUBJECT TO CHANGE AND MAY NOT BE REFERRED TO AS AN INTERNATIONAL STANDARD UNTIL PUBLISHED AS SUCH.

IN ADDITION TO THEIR EVALUATION AS BEING ACCEPTABLE FOR INDUSTRIAL, TECHNOLOGICAL, COMMERCIAL AND USER PURPOSES, DRAFT INTERNATIONAL STANDARDS MAY ON OCCASION HAVE TO BE CONSIDERED IN THE LIGHT OF THEIR POTENTIAL TO BECOME STANDARDS TO WHICH REFERENCE MAY BE MADE IN NATIONAL REGULATIONS.

RECIPIENTS OF THIS DRAFT ARE INVITED TO SUBMIT, WITH THEIR COMMENTS, NOTIFICATION OF ANY RELEVANT PATENT RIGHTS OF WHICH THEY ARE AWARE AND TO PROVIDE SUPPORTING DOCUMENTATION.

Reference number
ISO/DIS 11227:2025(en)

Full document details: 25/30486708 DC

© ISO 2025  **Documents**
Document Sharing Hub



COPYRIGHT PROTECTED DOCUMENT

© ISO 2025

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms, definitions, abbreviated terms and symbols	1
3.1 Terms and definitions	1
3.2 Abbreviated terms	3
3.3 Symbols	3
4 General requirements	4
5 Calibration	4
5.1 General	4
5.2 Impact parameters	4
5.3 General environment	5
5.4 Ejecta characterization	5
5.5 Report of calibration tests	5
6 Experimental procedure	5
6.1 General	5
6.2 Impact parameters	5
6.3 General environment	6
6.4 Ejecta characterization and evaluation	6
6.5 Additional tests	7
6.6 Analysis of test results	8
7 Reporting of test results	8
7.1 General	8
7.2 Report of testing of materials	8
7.2.1 Information on test sample	8
7.2.2 Description of test procedures	9
7.2.3 Presentation of test results	9
7.3 Database	9
8 Quality assurance	9
8.1 General	9
8.2 Quality requirements	9
8.2.1 Request for HVI testing of materials	9
8.2.2 Work proposal for HVI testing of materials	10
8.2.3 Calibration	10
8.2.4 Testing, evaluation and reporting	10
8.2.5 Traceability and records	10
Annex A (informative) Characterization of material ejected upon impact (ejecta)	11
Annex B (informative) Example of an ejecta model	13
Annex C (informative) Ejecta measurement methods	16
Annex D (informative) Example of a data sheet	21
Annex E (informative) Technical data	23
Bibliography	24

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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO [had/had not] received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 11227:2012) and its Amendment (ISO 11227:2012/Amd 1:2021), which have been technically revised.

The main changes are as follows:

- updated the terms and definitions section,
- updated annexes, specifically [Annex B](#) and [C](#).

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

Throughout its orbit lifetime, any spacecraft is exposed to the risk of collision with man-made space debris and natural micrometeoroids. Concentration of natural particles is nearly stable, but the number of man-made debris is likely to increase over time. Details concerning this space environment can be found in the documents cited in the bibliography (see References [1] and [2]).

Damage caused by meteoroids or debris can result in total or partial mission failure and in a potential generation of small debris. Because of the large collision velocities (hypervelocity domain), even a small object produces upon impact a large number of small particles, which are called ejecta. Ejecta can damage parts of the spacecraft itself and increase the population of space debris. The orbital lifetime of the ejecta depends on several factors such as size, initial velocity, and orbit altitude of the parent body. This population of space debris is already evaluated at a few percent of the total space debris population, and it is likely to increase in the future[3][4][5]. It is therefore necessary, for the mitigation of such particles, to assess the mechanism of their production.

As shown by previous experimental studies[6][7][8], the amount of ejecta depends primarily on the type of material exposed directly to the space environment. It is greater for brittle materials than for ductile materials; it depends also on the size and on the velocity of impacting particles. Consequently, the best approach for assessing the process is to perform laboratory impact simulation using hypervelocity launchers.

The purpose of this International Standard is to describe a standard approach for assessing the behaviors, under orbital debris or meteoroid hypervelocity impacts, of the materials that are used on the external surfaces of spacecraft[9].

Results obtained from the standard tests carried out on as wide a range of materials as possible will be stored in a database created for this purpose or incorporated into an existing one such as ECSS-Q70-71A (see [Annex D](#) and Reference [10]). This database will help designers choose spacecraft outer materials that mitigate the risk of space debris.

Space systems — Test procedures to evaluate spacecraft material ejecta upon hypervelocity impact

1 Scope

This document describes an experimental procedure for assessing the behaviors, under orbital debris or meteoroid impacts, of materials that are intended to be used on the external surfaces of spacecraft and launch vehicle orbital stages. This document provides a unified method by which to rank materials. The ejecta production characteristics of different materials are compared under standardized conditions in which test parameters are fixed to one number. Optional tests with different parameters are also useful for the proper selection of materials in other conditions, and they could be performed as research items.

This document establishes the requirements to be satisfied for the test methods in order to characterize the amount of ejecta produced when a surface material is impacted by a hypervelocity projectile. Its purpose is to evaluate the ratio of ejecta total mass to projectile mass, and the size distribution of the fragments. These are the necessary inputs for modelling the amount of impact ejecta that a surface material might release during its orbital lifetime, thereby helping to assess its suitability for space use while mitigating the production of small space debris.

The purpose of this document is to provide data that needs to be taken into account in the selection of outer spacecraft materials, though the selection is not based on these criteria alone.

The experimental procedure defines

- the type of facility to be used,
- the size, velocity and type of projectile to be used,
- the evaluation of impact ejecta released,
- reporting test results, and
- the quality requirements to be used.

It is anticipated that this document will be the first of several test procedure standards aimed at characterizing the release of small debris from the external surfaces of spacecraft and launch vehicle orbital stages as the result of interaction with the space environment. It is applicable to spacecraft and launch vehicles operating in all types of Earth orbits.

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 24113, *Space systems — Space debris mitigation requirements*

3 Terms, definitions, abbreviated terms and symbols

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 24113 and the following 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/>

3.1.1

brittle material

material that breaks due to a propagation defect under the action of stress

3.1.2

ductile material

material that can be plastically deformed without breaking under the action of stress

3.1.3

ejecta cone

shaped spray of fine particles, comprising fragments and spalls that are released during a high-velocity impact.

3.1.4

fragmentation

process by which an orbiting space object dissociates and produces debris, such as break-up, exposure to space environment, and ageing

3.1.5

hypervelocity impact

impact occurring with a velocity greater than the velocity of sound in any given material

3.1.6

impact crater

damage left on a material, generally hemispherical in shape, after a projectile has hit its surface without going throughout the material

3.1.7

light gas gun

LGG

experimental device consisting of a powder gun that compresses a low-density gas to accelerate a projectile up to hypervelocity

3.1.8

meteoroid

particles of natural origin, resulting from the disintegration and fragmentation of comets and asteroids, which orbit the sun

3.1.9

perforation

hole created by an impact on a thin material in which there is no formation of a crater

3.1.10

plasma gun

experimental device that produces an accelerated plasma flow, which is compressed in a coil and then drags a projectile up to hypervelocity

3.1.11

silica aerogel

low-density solid material, made with a porous, silica-based structure, used for the retrieval of ejecta fragments in impact experiments