International Standard

ISO 16159

Space systems — Launch pad and integration site — Facility, system and equipment failure analysis

Systèmes spatiaux — Aire de lancement et site d'intégration — Analyse de défaillance des installations, du système et de l'équipement

Second edition
2025-10

Reference number
ISO 16159:2025(en)

© ISO 2025



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 and definitions **1**
4 General requirements **3**
5 Methods of analysis **4**
6 Documentation and distribution of the failure analysis results **5**
7 Corrective and preventive actions **7**
Annex A (informative) **Possible corrective actions** **8**
Bibliography **9**

© ISO 2025 – All rights reserved

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 document 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 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 16159:2012), which has been technically revised.

The main changes are as follows:

— terms were updated.

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.

© ISO 2025 – All rights reserved

Introduction

Failure of the launch pad or integration site facility, system or equipment during acceptance testing or operation can be catastrophic. Failure of the facility, systems or equipment can damage flight or ground hardware and injure personnel. Failures must be thoroughly investigated in order to prevent future failures, damage and injuries. In order to investigate failures of launch pad or integration site facilities, systems or equipment, adequate processes and procedures must be employed to thoroughly analyse and determine the cause of the failure. Identification of failure causes is necessary to implement changes to the facility, system and equipment in order to prevent a recurrence of the failure and the resulting damage or injury. This document establishes procedures for determining the causes of facility, system and equipment failures and preventing such failures.

© ISO 2025 – All rights reserved

Space systems — Launch pad and integration site — Facility, system and equipment failure analysis

1 Scope

This document establishes procedures for the analysis of failures that occur during the acceptance testing or operation of launch pad and integration site facilities, systems and equipment. The procedures define the processes for investigating, analysing and identifying the probable causes of failures, and for developing corrective actions to preclude future failures.

This document provides:

— rules for investigating, analysing and identifying the causes of failures;

— sufficient information so that corrective action can be implemented to prevent failure recurrence;

— a uniform method for maintaining records of the findings of all failure causes so as to provide information for other failure investigations.

This document applies to launch pad and integration sites used for the launch of launch vehicle with spacecraft for public and commercial purposes.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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
failure
termination of the ability of an item to perform the function

[SOURCE: ISO 14620-1:2018, 3.1.9, modified — "a required function" has been replaced by "the function".]

3.2
failure analysis
logical systematic examination, after a *failure* (3.1), of an item, its construction, application and documentation in order to identify the failure mode and determine the failure mechanism and its basic cause

Note 1 to entry: Investigative techniques can range from examination in the field to evaluation in the laboratory.

3.3
launch pad
equipment and facility designed to provide for the pre-launch and launch operations of spacecraft

[SOURCE: ISO/TR 17400:2021, 3.3]

© ISO 2025 – All rights reserved

3.4
integration site
equipment and facility designed for launch vehicle storage, assembly and testing, and launch vehicle (space rocket) and spacecraft/payload(s) integration, post-integration testing, and launch preparation, maintenance, servicing and preparation for transportation to the *launch pad* (3.3)

[SOURCE: ISO/TR 17400:2021, 3.1]

3.5
design documentation
documentation created by the developer and containing the requirements for the design, manufacture, control, acceptance, operation, maintenance, modernization and utilization of a component

3.6
normative documentation
standards, specifications, rules or instructions, to which adherence is required through the design, manufacture and operation of the facility, system or equipment

3.7
production documentation
documentation (graphic or text) created by the facility, system or equipment contractor, which establishes the requirements for manufacture of the facility, system, equipment or component

3.8
failure analysis team
group of humans, which are competent and suitable for providing the *failure analysis* (3.2)

Note 1 to entry: The failure analysis shall be carried out in accordance with this document.

3.9
discrepant component
first component of a facility, a system or equipment that manifests *failure* (3.1)

Note 1 to entry: The discrepant component may or may not be the primary or initial component to fail.

3.10
complex
launch pad (3.3) or *integration site* (3.4)

[SOURCE: ISO 26870:2022, 3.2]

3.11
primary failed component
component, the *failure* (3.1) of which resulted in the compromised functionality of the component itself, of additional components or of the associated facility, system or equipment

3.12
functional track
sequence of components on which energy (mechanical, electric or pressure) is transferred from the *primary failed component* (3.11) to the *discrepant component* (3.9)

3.13
failure precondition
pre-existing conditions and circumstances that predispose a component to *failure* (3.1)

Note 1 to entry: Failure preconditions can include mistakes in design, manufacture or operation, and also personnel maintenance mistakes, software errors and errors of interface exchange between components, which are the predispose for the failure occurrence.

© ISO 2025 – All rights reserved

3.14
root cause
primal condition, event or circumstance, or initiating cause, that is ultimately responsible for the occurrence of a *failure* (3.1)

4 General requirements

4.1 For each component involved in the facility, system or equipment that failed, the following records shall be evaluated:

— design documentation;

— normative documentation;

— production documentation;

— acceptance test certificates and reports;

— relevant reports, log-books, schedules and certifications.

4.2 The failure analysis shall be carried out by a failure analysis team.

4.3 The failure analysis team shall be given the task of investigating a failure by:

— the facility, system, equipment or component developer or manufacturer, if the failure occurred prior to the deployment of the facility, system or equipment; or

— the customer, if failure occurred after the facility, system or equipment was deployed.

4.4 The failure analysis team shall include representatives of the facility, system or equipment developer and manufacturer and typically also includes representatives of:

— the operator;

— the component developer;

— the component manufacturer;

— the assembly organization;

— the maintenance organization;

— the expert on quality assurance;

— the customer.

4.5 The following shall also be considered when selecting the failure analysis team for the failure analysis:

— type of facility, system or equipment;

— type of discrepant component failure (e.g. structural, mechanical or electrical);

— symptoms of the failure;

— availability of information on the conditions prior to failure;

— environment and conditions at the failure site.

4.6 The operator and the customer shall jointly appoint one of the following to lead the failure analysis team:

— a representative of the developer, if the failure occurred during testing; or

© ISO 2025 – All rights reserved