
**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*

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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.

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 16159 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

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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 need to 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 International Standard establishes procedures for determining the causes of facility, system and equipment failures and preventing such failures.

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

1 Scope

This International Standard 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.

The purpose of this International Standard is to provide

- rules for investigating, analysing and identifying the causes of failures,
- sufficient information so that corrective action may be implemented to prevent failure recurrence, and
- a uniform method for maintaining records of the findings of all failure causes so as to provide information for other failure investigations.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1

complex

launch pad or integration site

[ISO 26870:2009, definition 3.2]

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2.2

discrepant component

first component of a facility, a system or equipment that manifests failure

NOTE The discrepant component may or may not be the primary or initial component to fail.

2.3

design documentation

documentation created by the developer and containing the requirements for the manufacture, fabrication, purchase or production of the components of the facility, system or equipment

2.4

failure

termination of the ability of an item to perform the function for which it was designed

[ISO 14620-2:2011, definition 3.5]

2.5

failure analysis

systematic approach to determine, as a minimum, the mode and mechanism of failure via investigative techniques, in order to identify and assess potential root causes and ultimately arrive at the most probable, and to identify and assess potential corrective actions and ultimately recommend/implement the most suitable

NOTE Investigative techniques can range from examination in the field to evaluation in the laboratory.

2.6 primary failed component
component, the failure of which resulted in the compromised functionality of the component itself, of additional components or of the associated facility, system or equipment

2.7 failure precondition
pre-existing conditions and circumstances that predispose a component to failure

NOTE Failure preconditions can include improper design, manufacture or service.

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

2.9 integration site
equipment and facility designed for launch vehicle storage, assembly, testing, preparation, maintenance, servicing and preparation for transportation to the launch pad

[ISO/TR 17400:2003, definition 3.1]

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

[ISO/TR 17400:2003, definition 3.3]

2.11 normative documentation
specifications, standards, rules or instructions, to which adherence is required through citation in the design documentation or the construction, fabrication, manufacture, purchase or production documentation for the manufacture and operation of the facility, system or equipment

2.12 production documentation
documentation created by the facility, system or equipment contractor, which establishes the requirements for construction, fabrication, manufacture or purchase of the facility, system, equipment or component

2.13 root cause
primal condition, event or circumstance, or initiating cause, that is ultimately responsible for the occurrence of a failure

3 General provisions

3.1 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;
- cogent reports, log-books, schedules and certifications.

3.2 The failure analysis shall be carried out by a team of experts.

3.3 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.

3.4 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, and
- the customer.

3.5 The following shall also be considered when selecting the failure analysis team experts:

- 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.

3.6 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
- a representative of the customer, developer, or manufacturer, if the failure occurred during operations.

3.7 The failure analysis team shall include a safety representative of

- the manufacturer, if the failure occurred during acceptance testing, or
- the operational organization, if the failure occurred during operations.

4 Methods of analysis

4.1 The failure analysis process generally includes the following steps or actions:

- a) gathering of information related to the failure, which applies not only to the failed component but also to the associated facilities, systems and equipment and which can include the following:
 - 1) facility, system or equipment;
 - 2) discrepant component failure (e.g. structural, mechanical or electrical);
 - 3) symptoms of failure;
 - 4) information on the conditions at the time of failure;