SLOVENSKI STANDARD
oSIST prEN 9227-2:2024

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Aeronavtika - Vodenje programa - Vodilo za nadzor zanesljivosti

Aerospace series - Programme management - Guide for reliability control

Luft- und Raumfahrt - Programm-Management - Richtlinien für das management der Zuvenlässigkeit

Série aérospatiale - Management de programme - Guide pour la maîtrise de la fiabilité

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ICS:		
49.140	Vesoljski sistemi in operacije	Space systems and operations

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English Version

Aerospace series - Programme management - Guide for reliability control

Série aérospatiale - Management de programme - Guide pour la maîtrise de la fiabilité

Luft- und Raumfahrt - Programm-Management - Richtlinien für das management der Zuvenlässigkeit

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee ASD-STAN.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (prEN 9227-2:2024) has been prepared by ASD-STAN.

This document is currently submitted to the CEN Enquiry.

After enquiries and votes carried out in accordance with the rules of this Association, this document has received the approval of the National Associations and the Official Services of the member countries of ASD-STAN, prior to its presentation to CEN.

1 Scope

The purpose of this document is to provide customers and their suppliers with a document specifying the notions of product reliability “construction” and “management”.

It offers programme directors and project managers information likely to help them:

— to determine the tasks to be performed and the application procedures, according to the specific nature of the programme and its goals;

— to define and implement the provisions necessary for performing these tasks;

— within programme execution, to situate the various tasks involved in constructing and managing the reliability of a product.

This document applies to all programmes (in particular aeronautical, space and armament programmes).

These reliability construction procedures concern not only all the products and its constituents covered by these programmes, but also the means and manufacturing processes to be implemented for their realization.

The provisions of this document can be negotiated at all levels between the parties directly concerned by a given programme. This implies, on the part of the customer, that each lower level is provided with the information necessary to perform tasks and meet the specified targets.

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
product
result of activities or processes

Note 1 to entry: product categories can be services, hardware, software, processed materials, intermediate work products from elementary activities, such as documents or models.

Note 2 to entry: in the frame of a product developed to satisfy a customer’s need, the processes involved are the expression of the need, the establishment of the definition, the industrialization and the production.

Note 3 to entry: the product can be either a final product to be delivered to a customer (e.g. aircraft, equipment) or one of its components. In both cases, it represents the supply due under the contract.

3.2
reliability
aptitude of a product to perform a required function, in given conditions, for a given period of time

Note 1 to entry: it is generally assumed that the product is in a state to perform this required function at the beginning of the time interval.

Note 2 to entry: generally, reliability performance is quantified using appropriate measures. In some applications, these measures include an expression of reliability performance as a probability, which is also called reliability.

[SOURCE: EN 16601-00-01:2015, 2.3.170 and ISO 10795:2019]

3.3
basic reliability
ability of a product not to fail for a specified period of time or for a specified life profile

Note 1 to entry: this amounts to put in a row all the elements constituting the product in question, in terms of "reliability".

Note 2 to entry: any failure is detrimental; in particular, a single failure on a redundant system reduces basic reliability.

Note 3 to entry: this notion is particularly important for the logistics associated with the product.

3.4
mission reliability
ability of a product to perform its assigned functions for a specified mission profile

Note 1 to entry: this aspect is observed by the user; in particular, a single failure on a redundant system will not reduce mission reliability.

3.5
reliability control
set of provisions and activities allowing to obtain the required reliability characteristics from a product

3.6
durability
ability of an item to perform a required function, under given conditions of use and maintenance, until the end of its useful life

Note 1 to entry: Useful life ends with the definitive cessation of use of the entity, and is determined by a limit state, i.e. when the risk of failure becomes unacceptable or when the entity is considered non-repairable following a failure. The limit state is linked most often to wear or degradation. An entity may be considered non-repairable when a repair cost is deemed unacceptable.

Note 2 to entry: In the case of non-repairable equipment, durability and reliability are synonymous. In the case of repairable equipment, the limit state is decided in relation to economic reasons, a benefit/risk balance, etc.

Note 3 to entry: Not to be confused with sustainable development performance.

Note 4 to entry: Lifetime is the necessary time between commissioning and reaching the limit state.

[SOURCE: adapted from EN 13306:2017 – notes added]

3.7
system
arrangement of parts or elements that together exhibit a stated behaviour or meaning that the individual constituents do not

Note 1 to entry: A system is sometimes considered as a *product* or as the *services* it provides.

Note 2 to entry: In practice, the interpretation of its meaning is frequently clarified by the use of an associative noun, e.g. aircraft system.

Note 3 to entry: A complete system includes all of the associated equipment, facilities, material, computer programs, firmware, technical documentation, *services*, and personnel required for operations and support to the degree necessary for self-sufficient use in its intended environment.

[SOURCE: adapted from ISO/IEC/IEEE 15288:2023 – note 2 incomplete]

4 List of acronyms

CIL	Critical items list
CMMS	Computerized maintenance management system
COTS	Commercial off-the-shelf
DJD	Definition justification dossier
EFA	External functional analysis
FMEA	Failure mode and effects analysis
FMECA	Failure mode, effects and criticality analysis
FPS	Functional performance specification
FRACAS	Failure reporting analysis and corrective actions system
IFA	Internal functional analysis
MBSA	Model-based safety analysis
MBSE	Model-based system engineering
MTBF	Mean operating time between failures
MTTR	Mean time to restoration
(N)TS	(Need) technical specification
RAMS	Reliability, availability, maintainability and safety
SEEA	Software errors effects analysis

5 Principles of reliability control

5.1 Purpose of reliability control

Its aim is to act in such a way:

— that the product achieves the necessary reliability to operate in accordance with the user needs, as expressed;

— that the product accomplishes the mission for which it is intended;

— that the economic constraints for setting up and operating the product are taken into account.

This implies making compromises between costs, lead-times and performance.

5.2 Construction of reliability

Construction of reliability is the set of actions to be carried out to control reliability.

It is important that all reliability activities are integrated into the product design/development/realization process through reliability construction and management activities (reliability control).

Construction of reliability can be efficient only if the results of reliability studies and analyses are taken into account as early as possible in the programme.

At this step, the actions carried out are the responsibility of the customer and of the supplier, their purpose being to express goals and requirements that are realistic both from a technical point of view and from a financial or calendar point of view.

This work results in a (need) technical specification [(N)TS] (see EN 9208), which specifies reliability characteristics consistent with the other performance criteria, namely maintainability, availability and safety.

Construction of reliability then continues throughout the design activities of the product in question (including during validation and qualification of the product), then during the realization and commissioning of this product.

Construction of reliability activity is carried out in accordance with the reliability, availability, maintainability and safety (RAMS) plan and with the requirements of the (N)TS and the management specification. Reliability is then maintained in accordance with this plan through to the disposal phase.

6 Construction of reliability tasks

6.1 Purpose of the clause

This clause explains the tasks that can be performed to construct reliability.

6.2 Calculation tasks

6.2.1 Reliability goals and allocation

The purpose of determining reliability goals and allocation is to:

— precise the reliability goals of the system and apply them to its constituent products (quantification of characteristics according to operational goals);

— identify the main axes of the programme that require effort, help to set priorities and define the necessary means.

Reliability goals and/or allocations are determined depending on the programme phase and after having:

— identified the need;

— defined and analysed the life profile of the system;

— identified the environmental conditions.

They are determined on the basis of system performance requirements. Product-specific reliability goals are allocated.

Their accuracy will depend on the experience acquired on similar systems (see 6.3.1):

— the basic reliability goals are established taking into account:

  o economic constraints (e.g. cost, goal);

  o safety constraints;

  o the overall availability of the installed products (which depends on the policy and on the maintenance means).

— the mission reliability goals for each mission can be defined based on:

  o the required probability of success;

  o the availability at the start of the mission;

  o other parameters likely to influence mission progress.

— the reliability goals for each component are defined based on:

  o the basic product reliability goals associated with each component;

  o the mission reliability goals;

  o the contribution of each component to the realization of the product's functions (deduced from the internal functional analysis – see 6.3.3) and the impact of potential failures of the component in terms of degradation of the product's functions (deduced from the risk analysis – see 6.3.1).

The reliability goals of a given component are thus defined in the form of basic reliability (in relation to the component and its life profile) and mission reliability goals (the missions of a component being defined by its expected functions). These goals are often translated into failure rates.

6.2.2 Reliability prediction

The purpose of reliability prediction is to assess basic and mission reliability to ensure the proposed design can meet the requirements.

Basic reliability is determined for each component on the basis of internal or external databases or from models referenced in documents such as FIDES and MIL-HDBK 217F for electronic components. This basic reliability data may take into consideration derating with respect to the maximum levels that these components can support.

Mission reliability is determined by modelling the product's architecture and mission profile. Assessments are carried out using the mathematical reliability models defined in subclause 6.3.4.

6.3 Analysis tasks

6.3.1 Risk analysis

The aim is to identify potential weaknesses of the product: general failure modes, effects of each adverse event according to the product's life profile situation.

This analysis is carried out at the level of the product and its constituents: all product events are examined and their effects on the missions and safety of people and goods are determined.