SLOVENSKI STANDARD
SIST EN 16602-30-09:2014

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Zagotavljanje varnih proizvodov v vesoljski tehniki - Analiza razpoložljivosti

Space product assurance - Availability analysis

Raumfahrtproduktsicherung - Verfügbarkeitsanalyse

Assurance produit des projets spatiaux - analyse de disponibilité

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49.140	Vesoljski sistemi in operacije	Space systems and operations

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Space product assurance - Availability analysis

Assurance produit des projets spatiaux - Analyse de disponibilité

Raumfahrtproduktsicherung - Verfügbarkeitsanalyse

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CEN-CENELEC Management Centre:
Avenue Marnix 17, B-1000 Brussels

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Foreword

This document (EN 16602-30-09:2014) has been prepared by Technical Committee CEN/CLC/TC 5 “Space”, the secretariat of which is held by DIN.

This standard (EN 16602-30-09:2014) originates from ECSS-Q-ST-30-09C.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2015, and conflicting national standards shall be withdrawn at the latest by March 2015.

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This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

This document has been developed to cover specifically space systems and has therefore precedence over any EN covering the same scope but with a wider domain of applicability (e.g. aerospace).

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1
Scope

This Standard is part of a series of ECSS Standards belonging to ECSS-Q-ST-30, Space product assurance – Dependability. The present standard defines the requirements on availability activities and provides where necessary guidelines to support, plan and implement the activities.

It defines the requirement typology that is followed, with regard to the availability of space systems or subsystems in order to meet the mission performance and needs according to the dependability and safety principles and objectives.

This Standard also describes the process that is followed and the most significant methodologies for the availability analysis to cover such aspects as

- evaluation of the space element or system availability figure,
- allocation of the requirement at lower level, and
- outputs to be provided.

This Standard applies to all elements of a space project (flight and ground segments), where Availability analyses are part of the dependability programme, providing inputs for the system concept definition and design development.

The on-ground activities and the operational phases are considered, for availability purposes, in order to

- acquire additional information essential for a better system model finalization and evaluation, and
- monitor the system behaviour to optimize its operational performance and improve the availability model for future applications.

This standard may be tailored for the specific characteristic and constraints of a space project in conformance with ECSS-S-ST-00.

2
Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this ECSS Standard. For dated references, subsequent amendments to, or revisions of any of these publications do not apply. However, parties to agreements based on this ECSS Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references the latest edition of the publication referred to applies.

EN reference	Reference in text	Title
EN 16601-00-01	ECSS-S-ST-00-01	ECSS system – Glossary of terms

3
Terms, definitions and abbreviated terms

3.1 Terms from other standards

For the purpose of this Standard, the terms and definitions from ECSS-S-ST-00-01- apply.

3.2 Terms specific to the present standard

3.2.1 achieved availability

probability that a system, subsystem or equipment, when used under stated conditions in an ideal support environment operates satisfactorily at a given time

NOTE The downtime is associated only to the active preventive and corrective maintenance.

3.2.2 active redundancy

every entity is operating and the system can continue to operate without downtime or defects despite the loss of one or more entities

3.2.3 corrective maintenance

maintenance performed to restore system hardware integrity following anomalies or equipment problems encountered during system operations

3.2.4 flight segment

product or a set of products intended to be operated in space

3.2.5 ground segment

all ground infrastructure elements that are used to support the preparation activities leading up to mission operations, the conduct of mission operations and all post-operational activities

3.2.6 hot redundancy

redundancy entity is “ON”, but not necessarily in the right configuration to accomplish the function

3.2.7 instantaneous availability

<intrinsic or inherent> probability that an item is in a state to perform a required function under given conditions at a given instant in time, assuming that the required external resources are provided

NOTE Preventive maintenance is generally not taken into account for intrinsic availability.

3.2.8 instantaneous availability

<operational> probability that an item is in a state to perform a required function under given conditions at a given instant of time, taking into account the maintenance strategy (spares policy and related in logistic delays and constraints)

3.2.9 lead time (supplier delay)

mean time for supplier to provide spares (including shipping time)

3.2.10 logistic delay

mean time for human and material maintenance means to be available (call-out time)

3.2.11 mean availability

<intrinsic or inherent> percentage of time that a system, subsystem or equipment, used under stated conditions without any scheduled or preventive action and with ideal logistical support, operates satisfactorily for a defined time period

3.2.12 mean availability

<operational> percentage of defined time period in which a system, subsystem or equipment, operates satisfactorily used under stated conditions in an actual support environment

NOTE The down time is relevant to the corrective maintenance, preventive maintenance, logistic and administrative delays.

3.2.13 mean down time

mean time between service interruption and service resumption

NOTE See Figure 3-1.

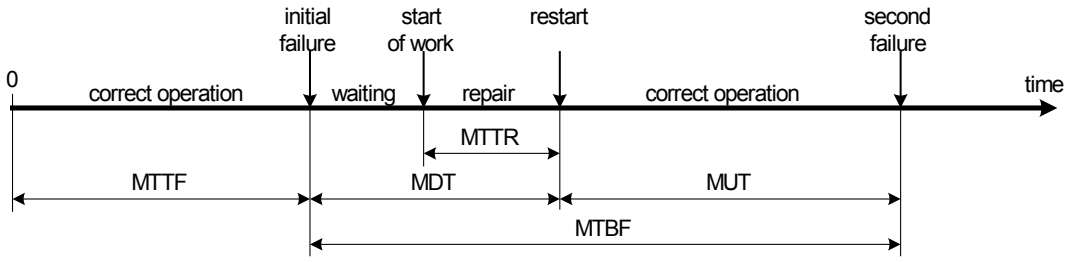

Figure 3-1: Relations between the various values that characterize the reliability, maintainability and availability of equipment

3.2.14 mean time between failures

mean time between two consecutive failures

3.2.15 mean time between outages

mean time of operation of an entity between two consecutive non-operational phases caused by corrective or preventive maintenance activities

3.2.16 mean time to failure

mean time of working of an entity before its first failure

NOTE Also known as “mean time to first failure” (MTTFF).

3.2.17 mean time to outage

mean time of working of an entity before its first outage

3.2.18 mean time to repair

mean duration to repair equipment with human and material maintenance means being available

3.2.19 mean up time

mean time of working of an entity after corrective maintenance (covering repair and replacement)

3.2.20 outage

state of an item of being unable to perform its required function

[IEC Multilingual Dictionary:2001 edition]

NOTE 1 Causes of outages can be failures, upsets or planned and unplanned events.

NOTE 2 The failures can be due to cataleptic intrinsic events or external events.

3.2.21 passive redundancy

redundancy not activated before necessary

NOTE Also knows as “standby redundancy” or “cold redundancy”.

3.2.22 preventive maintenance

scheduled or on-condition maintenance actions performed on equipment to reduce its probability of failure or degradation

NOTE Preventive maintenance is performed to keep the system at designed reliability and safety levels before failure occurrence.

3.2.23 steady-state availability (asymptotic availability)

limit, if any, on the instantaneous availability as time approaches infinite

3.3 Abbreviated terms

For the purpose of this Standard, the abbreviated terms from ECSS-S-ST-00-01 and the following apply:

Abbreviations	Meaning
FMECA	failure modes, effects and criticality analysis
GPS	global positioning system
LD	logistic delay
MDT	mean down time
MTBF	mean time between failures
MTBO	mean time between outages
MTTF	mean time to failure
MTTFF	mean time to first failure
MTTO	mean time to outage
MTTR	mean time to repair
MUT	mean up time
NRB	nonconformance review board
PDF	probability density function
RAM	reliability availability and maintainability
SOW	statement of work
TWT	travelling wave tube
w.r.t.	with respect to