SLOVENSKI STANDARD
SIST EN 16603-34:2014

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Vesoljska tehnika - Nadzorovanje okolja in omogočanje življenja

Space engineering - Environmental control and life support (ECLS)

Raumfahrttechnik - Umweltkontrolle und Lebenserhaltung (ECLS)

Ingénierie spatiale - Contrôle de l'environnement et support de vie pour les vols habités

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13.020.99	Drugi standardi v zvezi z varstvom okolja	Other standards related to environmental protection
49.140	Vesoljski sistemi in operacije	Space systems and operations

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Space engineering - Part 34: Environmental control and life support (ECLS)

Ingénierie spatiale - Partie 34: Contrôle de l'environnement et support de vie pour les vols habités

Raumfahrttechnik - Teil 34: Umweltkontrolle und Lebenserhaltung (ECLS)

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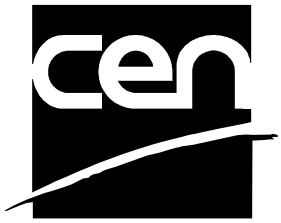

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Table of contents

Tables

Foreword

This document (EN 16603-34:2014) has been prepared by Technical Committee CEN/CLC/TC 5 “Space”, the secretariat of which is held by DIN.

This standard (EN 16603-34:2014) originates from ECSS-E-ST-34C.

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of an identical text or by endorsement, at the latest by February 2015, and conflicting national standards shall be withdrawn at the latest by February 2015.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

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 addresses the discipline of environmental control and life support (ECLS) and the interfaces to other disciplines of engineering and to the domains of management and product assurance.

It also introduces the structure and applicability of the associated Level 3 Standards.

The environmental control and life support systems (ECLSS) covered in this Standard includes those aspects relating to the assurance of a safe and comfortable environment for human beings undertaking a space mission.

When other forms of life are accommodated on board, the ECLSS also ensures the appropriate environmental conditions for those living organisms.

This Standard applies to all ECLSS for:

- all manned space endeavours and man-rated space products, and
- any other form of life to be maintained on board.

This standard may be tailored for the specific characteristics and constrains 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 revision 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 more 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
EN 16003-10-02	ECSS-E-ST-10-02	Space engineering — Verification

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 anoxic

gas or atmosphere containing no oxygen

3.2.2 closed-loop ECLSS

ECLSS based on recycling, regeneration, and recovery of materials or elements

NOTE The closed-loop ECLSS implies that the use of significant expendables and consumables is excluded from the processes.

3.2.3 compression

EVA related action to increase total pressure

3.2.4 decompression

EVA related action to reduce the total pressure

3.2.5 depressurization

action to reduce the total pressure

3.2.6 environmental control and life support (ECLS)

engineering discipline dealing with the physical, chemical and biological functions to provide humans and other life forms with suitable environmental conditions

NOTE The objective of ECLS is to create a suitable environment by controlling the environmental parameters, providing resources, and managing waste products.

3.2.7 environmental control and life support system (ECLSS)

system that includes the hardware and software to perform ECLS functions

3.2.8 hypoxic

gas or atmosphere containing oxygen that provides a partial pressure of oxygen below the specified range of oxygen partial pressure in the atmosphere of habitable volumes

3.2.9 open-loop ECLSS

ECLSS based on external resupply of resources

3.2.10 partial pressure

participation of one of the constituents of a gas mixture or an atmosphere in the total pressure

NOTE 1 Examples include:

- PCO_2, stands for partial pressure of carbon dioxide,
- PH_2O, stands for water vapour partial pressure.

NOTE 2 To calculate a partial pressure, the fraction of the constituent is multiplied by the total pressure. For example, the partial pressure of oxygen on Earth is:
$PO_2 = 0{,}21 \times 1{,}013 \times 10^6 \text{ Pa} = 0{,}213 \times 10^6 \text{ Pa}$.

NOTE 3 Abbreviation for partial pressure is P followed by the chemical formula of the constituent.

3.2.11 pressurization

action to increase the total pressure

3.2.12 re-compression

<EVA>

EVA related action to restore the total pressure after decompression or to treat decompression illness

3.2.13 re-compression

<Other than EVA>

action to restore the total pressure after depressurization

3.2.14 re-pressurization

action to restore the total pressure after depressurization

3.2.15 safe haven

facility capable of sustaining human life under emergency conditions as a minimum, in the case of a life threatening situation

3.3 Abbreviated terms

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

Abbreviation	Meaning
CFU	colony forming unit
DCI	decompression illness
ECSL	environmental control and life support
ECLSS	ECLS system
EM	engineering model
EMC	electromagnetic compatibility
EMU	EVA mobility unit
EVA	extra-vehicular activity
FDIR	failure detection, isolation and recovery
FM	flight model
FOV	field of view
GSE	ground support equipment
ICD	interface control document
ISS	International Space Station
IVA	intra-vehicular activity
multi-g	more than 1-g acceleration situation
QM	qualification model
SMAC	spacecraft maximum allowable concentration
TCS	thermal control system

4 Requirements

4.1 Overview

Requirements defined in this Standard are specific to ECLSS, including requirements for functional objectives of the system or requirements for the safety of life.

Requirements are not quantified with values for the parameters. Quantified specifications are established on a case-by-case basis for project dependent items. Examples of parameters to be specified are listed in Annex A

4.2 Mission and system

4.2.1 General

a. The ECLSS shall be designed for a specific mission and all phases within that mission as defined in 4.2.2, up to the end of the operational lifetime.

4.2.2 Mission

4.2.2.1 Overview

Basic requirements on the ECLSS vary according to the mission scenarios and the mission phases of the selected mission. The most important parameters affecting the requirements are the mission duration, the size of the crew, the type and quantity of living organisms, the availability of a source of resupply (e.g. Earth and space cargo) and the feasibility or duration of any saving, rescue or evacuation procedure.

The longer the mission duration and the larger the distance from the source of resupply (e.g. Earth) are the more difficult the rescue becomes and the higher the dependence is on ECLSS closed loops.

4.2.2.2 Identification of requirements

a. ECLSS requirements related to each mission phase shall be identified in project Phase A.

NOTE For project phases and planning, see ECSS-M-ST-10.

4.2.2.3 Mission phases

a. The applicable conditions for the following mission phases shall be included in the ECLSS definition:

1. ground and pre-launch operations;
   (a) storage, transport;
   (b) functional check out;
   (c) waiting on launch pad.
2. launch and ascent;
   (a) launch time;
   (b) external environment;
   (c) specific requirements during multi-g phases;
   (d) impact of depressurization and re-pressurization (IVA);
   (e) launch abort situation.
3. planetary orbital phase;
4. transfer phase;
5. docking, docked and separation phases, rendezvous and parking;
6. extra-vehicular activity: pre-breathing
7. planetary phase;
   (a) landing, mission on planet;
   (b) planetary walk;
   (c) excursion, rover, supported excursion.
8. return to Earth, descent, reentry and landing;
9. post landing phases, quarantine.

NOTE Manned and unmanned phases can be part of a given mission.

b. The storage and transport conditions for supplies shall be specified.

c. External environmental conditions, both on ground and in space shall be taken into account.

4.2.3 System

4.2.3.1 Multi-ECLSS phases

4.2.3.1.1 Applicability

The requirements in 4.2.3.1.2 apply to each of the several pressurized volumes that can be involved in a given mission, each with its own ECLSS to work

independently during some phases of the mission, for the duration of the independent operations (example EVA suit).

4.2.3.1.2 Requirements

a. Interfaces shall be defined for the period of time when several pressurized volumes having independent ECLSSs are mated.

b. When an ECLSS is not in operation during a given phase of the mission, standby mode conditions shall be defined.

c. When docking to another spacecraft, the various ECLSSs involved shall be compatible.

4.2.3.2 Reusable systems

a. When a vehicle is used for several missions, the following issues shall be addressed during the design phase (project Phase B):

1. standby, storage and parking conditions between missions;

2. recommissioning procedure before next mission.

4.3 General

4.3.1 Forms of life

4.3.1.1 Humans

The ECLSS can be designed for a mixed or an unmixed crew.

For human factors such as metabolism and anthropometrics, see ECSS-E-ST-10-11.

4.3.1.2 Forms of life other than humans

4.3.1.2.1 Metabolism

a. Requirements for energy and for overall intake and output of consumables shall be defined at the beginning of the ECLSS development programme (project Phase A).

4.3.1.2.2 Environmental conditions

a. Environmental conditions for the forms-of-life to support shall be defined at the beginning of the programme (project Phase A).

NOTE It is important to define such environmental condition because it is usually form of life dependent.