**SLOVENSKI STANDARD**
**SIST EN 16603-60-21:2018**

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**Vesoljska tehnika - Terminologija na področju žiroskopov in tehnična specifikacija**

Space engineering - Gyros terminology and performance specification

Raumfahrttechnik - Kreiselinstrumente - Terminologie und Leistungsspezifikation

Ingénierie spatiale - Spécification des performances et terminologie des gyros



**Ta slovenski standard je istoveten z: EN 16603-60-21:2018**



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| 01.040.49 | Letalska in vesoljska tehnika (Slovarji) | Aircraft and space vehicle engineering (Vocabularies) |
| 49.140 | Vesoljski sistemi in operacije | Space systems and operations |

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English version

# Space engineering - Gyros terminology and performance specification

Ingénierie spatiale - Spécification des performances et terminologie des gyros

Raumfahrttechnik - Kreiselinstrumente - Terminologie und Leistungsspezifikation

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# European Foreword

This document (EN 16603-60-21:2018) has been prepared by Technical Committee CEN-CENELEC/TC 5 “Space”, the secretariat of which is held by DIN.

This standard (EN 16603-60-21:2018) originates from ECSS-E-ST-60-21C.

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of an identical text or by endorsement, at the latest by March 2019, and conflicting national standards shall be withdrawn at the latest by March 2019.

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



This document has been prepared under a standardization request 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, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

# Introduction

This Standard is intended to support the variety of space borne gyros either available or under development, with the exception of the gyros used for the launch vehicles.

This standard defines the terminology and specifications for the functions and performance of gyros used on spacecraft. It focuses on the specific topics to be found in the gyros procurement specification documents and is intended to be used as a structured set of systematic provisions.

This standard is split in three main clauses:

- Terminology (clause 3)
- Functional requirements (clause 4)
- Performance requirements (clause 5)

NOTE This standard does not contain textbook material on gyro technology. The readers and the users are assumed to possess general knowledge of gyro technology and its applications to space missions.

# 1 Scope

This Standard specifies gyros functions and performances as part of a space project. This Standard covers aspects of functional and performance requirements, including nomenclature, definitions, functions and performance metrics for the performance specification of spaceborne gyros.

The Standard focuses on functional and performance specifications with the exclusion of mass and power, TM/TC interface and data structures.

When viewed from the perspective of a specific project context, the requirements defined in this Standard can be tailored to match the genuine requirements of a particular profile and circumstances of a project.



The requirements verification by test can be performed at qualification level only or also at acceptance level. It is up to the Supplier, in agreement with the customer, to define the relevant verification approach in the frame of a specific procurement, in accordance with clause 5.2 of ECSS-E-ST-10-02.



The present standard does not cover gyro use for launch vehicles.

This standard can be tailored for the specific characteristics 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 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 |

# 3
# Terms, definitions and abbreviated terms

## 3.1 Terms from other standards

a. For the purpose of this Standard, the terms and definitions from ECSS-S-ST-00-01 apply, in particular the following terms:

1. acceptance
2. assembly
3. availability
4. configuration
5. failure
6. lifetime
7. performance
8. qualification
9. redundancy



## 3.2 Terms specific to the present standard

### 3.2.1 alignment reference frame (ARF)

frame that is fixed with respect to the gyro external optical cube where and whose origin is defined unambiguously with reference to the gyro external optical cube

NOTE 1 The X, Y and Z axes of the ARF are a right-handed orthogonal set of axes which are defined unambiguously with respect to the normal of the faces of the external optical cube. Figure 3-1 schematically illustrates the definition of the ARF.

NOTE 2 If the optical cube's faces are not perfectly orthogonal, the X-axis can be defined as the projection of the normal of the X-face in the plane orthogonal to the Z-axis, and the Y-axis completes the RHR.

NOTE 3 The ARF is the frame used to align the sensor during integration.

NOTE 4 This definition does not attempt to prescribe a definition of the ARF, other than it is a frame fixed relative to the physical geometry of the sensor optical cube.

NOTE 5 This term is defined in the present standard with a different meaning than in ECSS-E-ST-60-20. The term with the meaning defined herein is applicable only to the present standard.

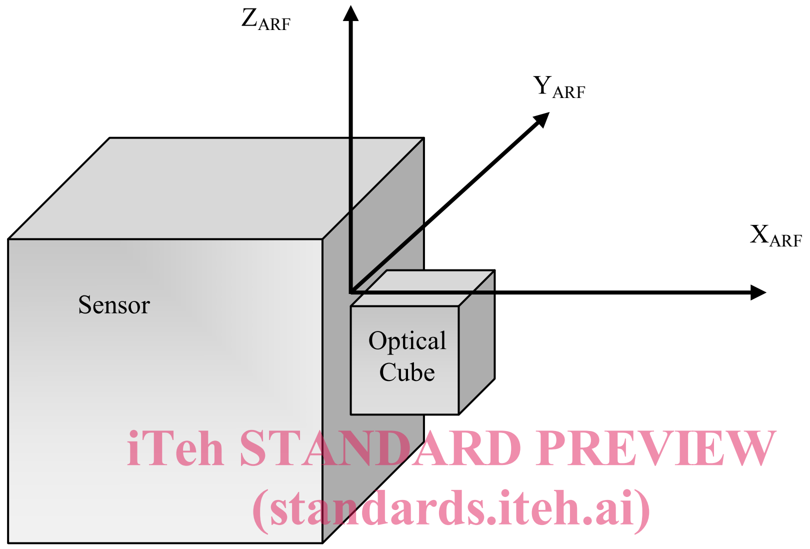




**Figure 3-1: example alignment reference frame**

### 3.2.2 angular increment

angular rotation between two user requests

### 3.2.3 angular random walk (ARW)

white noise on the gyro rate output, corresponding to a -1 slope on the Allan variance plot to a -1/2 slope on the Allan variance standard deviation plot and to a flat slope on the PSD plot

NOTE The plots are measured in log/log scale.

### 3.2.4 angular white noise (AWN).

white angle noise which corresponds to a -2 slope on the Allan variance plot, to a -1 slope on the Allan variance standard deviation plot and to a +2 slope on the PSD plot.

NOTE The plots are measured in log/log scale.

### 3.2.5 anti-aliasing filter

filter implemented in the gyro in order to avoid the aliasing of the high frequency motion of the spacecraft input signal

### 3.2.6 bias

gyro measurement errors that are non-stochastic and not input rate dependant, computed as the average of the rate error value over a defined time period

NOTE This term is defined in the present standard with a different meaning than in ECSS-E-ST-60-20. The term with the meaning defined herein is applicable only to the present standard.

### 3.2.7 bias instability

low frequency noise component corresponding to flat slope on the Allan variance standard deviation plot and to a -1 slope on the PSD plot

NOTE The plots are measured in log/log scale.

### 3.2.8 calibration

set of activities based on a set of tests allowing to characterise the gyro non-random performance and, when relevant, to define the compensation parameters used to improve the performance

NOTE This term is defined in the present standard with a different meaning than in ECSS-S-ST-00-01. The term with the meaning defined herein is applicable only to the present standard.



### 3.2.9 configuration status

telemetry word indicating the states of the gyro tuneable settings

NOTE The configuration status scope is typically defined by the gyro supplier.



### 3.2.10 cumulated angular increments

summation of angular increments

NOTE cumulated increments data output do not correspond to an angular rotation between two requests but to a cumulated angular rotation. The customer typically manages the overflow. The use of cumulated angular increments is robust to transient data transmission issue.

### 3.2.11 deadband

input rotation range inside which the gyro output variation is less than a specified value of the movement applied variation

NOTE The specified valued is normally expressed as a percentage of the movement applied variation.

### 3.2.12 frozen outputs

situation occurring when the gyro output is erroneously identical over several measurement acquisitions despite variation of the input signal

### 3.2.13 health status

telemetry word which contains the gyro internal monitoring survey results

NOTE The internal monitoring survey parameters are defined by the gyro supplier.

### 3.2.14 input axis misalignment

angular error between the real sensing axis and the gyro reference sensing axis

### 3.2.15 multiple-axis configuration

gyro configuration with several sensing axes on the same mechanical structure and oriented along different directions, physically defined w.r.t. the mechanical reference frame (MRF) or the alignment reference frame (ARF)

### 3.2.16 noise

high frequency or short duration errors

NOTE 1 Noise measurements and noise model characterization can be done at various temperatures. However, during noise measurement, gyro channel environmental temperature is assumed identical within a specified temperature range.



NOTE 2 This term is defined in the present standard with a different meaning than in ECSS-E-ST-32-11. The term with the meaning defined herein is applicable only to the present standard.



### 3.2.17 quantisation error

noise due to the digital nature of the gyro output

NOTE This component of noise has the same asymptotic behaviour than the AWN on Allan variance and PSD plots.

### 3.2.18 repeatability

degree of closeness of test results taken during different periods of operations

NOTE 1 For instance before and after thermal cycles and other environmental exposures, between shutdowns and according to time between runs. Unless otherwise specified, measurements are carried-out in the same environmental conditions (in particular, gyro channel environmental temperature being assumed identical within a specified temperature range).

NOTE 2 This term is defined in the present standard with a different meaning than in ECSS-E-ST-35 and ECSS-Q-ST-20. The term with the meaning defined herein is applicable only to the present standard.

### 3.2.19 rate random walk (RRW)

noise component which corresponds to a +1 slope on the Allan variance plot to a +1/2 slope on the Allan variance standard deviation plot and to a -2 slope on the PSD plot.

NOTE The plots are measured in log/log scale.

### 3.2.20 scale factor non linearity

deviation of the output from a reference scale factor, over a given dynamic range

NOTE the scale factor non linearity can be determined, for example, by a least square linear fit of the input/output data

### 3.2.21 scale factor non linearity error

residual errors after compensation of the scale factor non linearity component

### 3.2.22 scale factor error

gyro measurement errors that are non-stochastic and dependant of the rate applied on the input axis

### 3.2.23 sensitivity



variation induced by a given environmental change, all other environmental conditions being assumed unchanged and gyro channel being in continuous operation

NOTE An environmental change can be, for example, a change in temperature.



### 3.2.24 single-axis configuration

gyro configuration with only one sensing axis

### 3.2.25 stability

variation over a defined time period during which the gyro channel is continuously submitted to specific operating conditions

NOTE Unless otherwise specified, measurements are carried-out in the same environmental conditions (in particular, gyro channel environmental temperature being assumed identical within a specified temperature range).

### 3.2.26 start-up phase

time interval between the switch-on of the gyro unit and the presence of a valid output of the gyro that is fulfilling the pertaining performance requirements

NOTE See also Figure 4-1.

### 3.2.27 stimulation

function that allows to inject a simulated dynamic angular profile to the gyro for ground test purposes