

STN	Letectvo a kozmonautika Všeobecné odporúčanie na architektúru BIT v integrovanom systéme	STN EN 9721 31 0311
------------	---	---

Aerospace series - General recommendation for the BIT Architecture in an integrated system

Táto norma obsahuje anglickú verziu európskej normy.
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 04/22

Obsahuje: EN 9721:2021

134633



EUROPEAN STANDARD

EN 9721

NORME EUROPÉENNE

EUROPÄISCHE NORM

December 2021

ICS 49.020

English Version

Aerospace series - General recommendation for the BIT Architecture in an integrated system

Série aérospatiale - Recommandations générales pour
l'architecture des BIT dans un système intégré

Luft- und Raumfahrt - Allgemeine Empfehlungen für
die integrierte Prüfungs-(BIT)-Architektur in einem
integrierten System

This European Standard was approved by CEN on 2 November 2020.

This European Standard was corrected and reissued by the CEN-CENELEC Management Centre on 23 February 2022.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

EN 9721:2021 (E)

Contents	Page
European foreword	5
Introduction	6
1 Scope.....	7
2 Normative references.....	7
3 Terms, definitions and abbreviations	7
3.1 Terms and definitions	7
3.2 Abbreviations.....	13
4 <i>BIT</i> stakeholders	15
4.1 <i>BIT</i> specifier	15
4.2 <i>BIT</i> designer/developer	15
4.3 Operational user	15
4.4 Maintenance engineer.....	15
4.5 System technical manager	16
4.6 Expert.....	16
4.7 Field data engineer.....	16
5 System constraints	16
5.1 System design.....	16
5.2 <i>BIT</i> interface function	17
5.2.1 The alarm function	17
5.2.2 The diagnostic function	18
5.2.3 Built-in reconfiguration.....	18
5.2.4 The maintenance function.....	18
5.2.5 The data recording for post analysis function	18
5.3 System technical states.....	19
5.4 Functional modes of a system	19
5.5 System configuration.....	19
5.5.1 Operational configuration of a system.....	19
5.5.2 Technical configuration.....	20
5.5.3 <i>BIT</i> parameterisation	20
6 <i>BIT</i> types and metrics.....	21
6.1 General.....	21
6.2 The various types of <i>BIT</i>	21
6.2.1 Power-up <i>BIT</i> or Power-on <i>BIT</i> (<i>PBIT</i>)	21
6.2.2 Initiated <i>BIT</i> (<i>IBIT</i>) or Demanded <i>BIT</i> (<i>DBIT</i>)	22
6.2.3 Continuous <i>BIT</i> (<i>CBIT</i>).....	22
6.2.4 External <i>BIT</i> (<i>EBIT</i>).....	22
6.2.5 Maintenance <i>BIT</i> (<i>MBIT</i>).....	22
6.2.6 Summary of characteristics of the various types of <i>BIT</i>	23
6.3 The metrics	23
6.3.1 Role of the mathematical definitions of the metrics	23
6.3.2 Detection rate.....	24
6.3.3 Isolation rate	26
6.3.4 Unreliabilisation rate caused by the <i>BIT</i>	29
6.3.5 False alarm rates, false correct operation rates	29

7	Use of <i>BIT</i>	34
7.1	During development.....	34
7.2	During production.....	34
7.3	During service.....	35
7.3.1	In operational mode	35
7.3.2	In maintenance mode.....	35
7.4	During validation during repair.....	35
8	Architecture of the <i>BIT</i>	35
8.1	The generic functions of the <i>BIT</i>	35
8.1.1	General	35
8.1.2	<i>BIT</i> Detection function	37
8.1.3	<i>BIT</i> Supervisor function.....	37
8.2	The various architectures of the <i>BIT</i> function	40
8.2.1	General	40
8.2.2	Distributed <i>BIT</i> Architecture	41
8.2.3	Centralised <i>BIT</i> Architecture	41
8.2.4	Choice of <i>BIT</i> architecture	42
8.3	Exchanged data typology	43
8.4	<i>BIT</i> specification and modelling.....	44
8.4.1	Specification process.....	44
8.4.2	System design arbitrations: Essential objective and effort.....	44
8.4.3	The <i>BIT</i> specification process.....	46
8.5	Generic modelling and configuration language.....	47
8.5.1	Introduction	47
8.5.2	General information	49
8.5.3	Description of the language tables.....	50
8.5.4	Functional language.....	56
8.5.5	Model instantiation process	57
8.6	Development process and validation/verification of a <i>BIT</i> system	57
9	Prognosis	57
9.1	Aim of the prognosis.....	57
9.2	Organisation of the prognosis.....	58
9.3	Data from <i>BIT</i> for use by the Prognosis	58
10	Conclusions	58
Annex A (informative) Examples		60
A.1	Operational efficiency and performance	60
A.1.1	General	60
A.1.2	Example 1: How do you cut down a tree rapidly?	60
A.1.3	Example 2: How do you cut a slab of butter cleanly?	60
A.2	Example of calculations for some metrics	61
A.2.1	General	61
A.2.2	Calculating detection rates.....	65
A.2.2.1	Calculating the <i>FDC</i> (Failure Detection Capability)	65
A.2.2.2	Calculating the <i>FDP</i> (Failure detection probability)	66
A.2.3	Calculating isolation rates.....	67
A.2.3.1	Calculating the <i>FIP_n</i> (Failure isolation probability)	68

EN 9721:2021 (E)

A.2.3.1.1	General	68
A.2.3.1.2	Calculating FIP_1	68
A.2.3.1.3	Calculating FIP_2	69
A.2.3.1.4	Calculating FIP_3	69
A.2.3.2	Calculating the FRP_n (Failure resolution probability)	69
A.2.3.2.1	General	69
A.2.3.2.2	Calculating FRP_1	72
A.2.3.2.3	Calculating FRP_2	72
A.2.3.2.4	Calculating FRP_3	73
A.3	Correct operation diagnostic vs failure diagnostic	73
A.4	Example of propagation of the diagnostic values on a simple architecture case	74
A.5	Ergodicity hypothesis	80
A.6	Example of calculation for assessing the NFF — No fault found rate	80
A.7	Timing chart of events	82
Annex B (informative) List of recommendations		84
Bibliography		87
Index		88

European foreword

This document (EN 9721:2021) has been prepared by the Aerospace and Defence Industries Association of Europe — Standardization (ASD-STAN).

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.

This document shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2022, and conflicting national standards shall be withdrawn at the latest by June 2022.

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.

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

EN 9721:2021 (E)**Introduction**

A Built-in-test (*BIT*) is a test carried out exclusively with the hardware and software resources specific to an item of equipment/system, in order to test it and/or its sub-assemblies, in view of detecting failures and isolating or even diagnosing them.

System designers are faced with the following questions:

- How do you define a strategy or method for a test built into a system?
- How do you assess the operational efficiency of a system's *BIT* architecture? (False alarms, non-reproducible alarms and false removals)
- How do you obtain a coherent *BIT* architecture between the various levels of a system? of a system of systems?
- How do you take into account the needs of the various users of the *BIT* function bearing in mind that the implementation, accesses, *BIT* reports, etc. are specific to the users?

1 Scope

The purpose of this document is to harmonise the dialogue between manufacturers, prime contractors, owners and the customer in view of making it easier to draw up specifications, share BIT architecture models and the *BIT* technical configuration of systems during the operational use phase.

This recommendation proposes adopting *BIT* operational efficiency and performance definitions, architecture design principles, and *BIT* specification or validation principles. It provides no recommendations regarding the numeric values for operational efficiency or performance. The diversity of situations, development of technological solutions and ever-changing operational requirements make it impossible to list general recommendations.

Clause 6 and Clause 9 set out the general context of use of the *BIT*.

Clause 7 lists the constraints to be taken into account to design a *BIT* architecture.

Clause 8 lists the various *BIT* types currently known and the definitions of performance and operational efficiency (metrics).

Clause 10 provides recommendations on the *BIT* architecture.

Clause 11 recommends a language for exchanging *BIT* architecture models for assembling the complete model of a system.

Clause 12 is an introduction to the prognosis.

This document is mainly intended for system designers.

Although it is based on examples of aeronautic systems, it is applicable to any type of system.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5577, *Non-destructive testing — Ultrasonic testing — Vocabulary*

koniec náhľadu – text ďalej pokračuje v platenej verzii STN