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Edition 1.1 2023-12
CONSOLIDATED VERSION

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Dynamic modules –
Part 2-1: Reliability qualification – Test template

Modules dynamiques –
Partie 2-1: Qualification de fiabilité – Modèle d'essai

IEC 62343-2-1:2019-09+AMD1:2023-12 CSV(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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This consolidated version of the official IEC Standard and its amendment has been prepared for user convenience.

IEC 62343-2-1 edition 1.1 contains the first edition (2019-09) [documents 86C/1567/CDV and 86C/1594/RVC] and its amendment 1 (2023-12) [documents 86C/1868/CDV and 86C/1888/RVC].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.

International Standard IEC 62343-2-1 has been prepared by subcommittee 86C: Fibre optic systems and active devices, of IEC technical committee 86: Fibre optics.

This first edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to IEC 62343-2:2014:

a) addition of an Introduction to the background of this document;
b) replacement of "Reliability qualification consideration" by "reliability qualification test consideration";
c) deletion of the consideration of "Design 1" and "Design 2" and change of the contents of "Approach" in "Reliability qualification test considerations";
d) deletion of the details in "Reliability qualification requirements" and replacement by "Reliability qualification test items";
e) deletion of "Reliability calculations" from the sum of failure rates of constituting parts;
f) Integration of "Pass/fail criteria" and "Guidance of FMEA" into Annex B (informative);
g) Simplification of test items and conditions in Annex A and change of title of Annex A to "Examples of reliability qualification test conditions".

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 62343 series, published under the general title *Dynamic modules,* can be found on the IEC website.

The committee has decided that the contents of this document and its amendment will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

IMPORTANT – The *'colour inside'* logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

NOTICE

INTRODUCTION

Dynamic modules (DMs) are relatively new fibre optic devices. In the industry, there is no de-facto standard of reliability qualification test requirements for DMs. Also, there are many types and functions of DMs, such as optical path switching, wavelength management, chromatic dispersion management, optical channel power management, and optical channel powers and wavelength monitoring. Therefore, it is difficult to standardize the reliability qualification test requirements because their functionality is so diverse. For DMs, a reliability qualification test template rather than particular requirements has been standardized.

The first edition of IEC 62343-2, *Dynamic modules – Part 2: Reliability qualification,* was published in 2011, and the second edition was published in 2014. A survey on reliability qualification test items and conditions was carried out in Japan, China, North America and Europe in 2015 and 2016. The survey revealed that several reliability test conditions were inconsistent with those in IEC 62343-2:2014, and the responses indicated a lack of consensus. As a result of the discussion in SC 86C, it was agreed that it was impossible to unify the test conditions for the reliability qualification of DMs. Instead of a reliability qualification document, it was decided to prepare this template for a reliability qualification test for DMs. Consequently, IEC 62343-2:2014 will be withdrawn and replaced upon publication of this document.

DYNAMIC MODULES –

Part 2-1: Reliability qualification – Test template

1 Scope

This part of IEC 62343 provides a reliability qualification test template for dynamic modules (DMs). The template describes the reliability qualification test items and provides information on requirements or options. Example test conditions are given for information purposes in Annex A.

For reliability qualification purposes, some information about the internal components, parts and interconnections is needed. These internal parts are treated as black boxes. This document gives requirements for the evaluation of DM reliability by combining the reliability of such internal black boxes.

The object of this reliability qualification test template is to provide a framework for the reliability qualification tests for DMs. Developers of reliability qualification tests for DMs determine the test conditions for each test item by referring to the examples in Annex A.

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.

IEC 62343, *Dynamic modules – General and guidance*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purpose of this document, terms and definitions given in IEC 62343 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
failure
non-compliance to product specification or change in parameters as set by the standard or agreed by the customer and supplier

3.1.2
qualification
formal test process to determine whether or not the product is suitable for applications

Note 1 to entry: "Pass or fail" is the expected outcome.

Note 2 to entry: This is different from a reliability test, which is an engineering test designed to understand the reliability consideration or estimate the reliability of the product; pass or fail is not the main result.

3.1.3
reliability
probability of performing required functions at specified operating and environmental conditions over time

Note 1 to entry: The reliability of a DM is expressed by either of the following two parameters: mean time between failure (MTBF) and failure in time (FIT):

- the MTBF is the mean period of DM continuous operation without any failure at specified operating and environmental conditions;
- the FIT is the number of failures expected in 10^9 device-hours at specified operating and environmental conditions.

3.2 Abbreviated terms

Each abbreviated term introduced in this document is explained in the text at least the first time it appears. However, for an easier understanding of the whole text, the following is a list of all abbreviated terms used in this document:

DM	dynamic module
EMC	electro-magnetic compatibility
FIT	failure in time
FMEA	failure mode and effects analysis
IL	insertion loss
LCD	liquid crystal device
MEMS	micro electro-mechanical system
MTBF	mean time between failure
RH	relative humidity

4 Reliability qualification test considerations

4.1 General

Since dynamic modules (DMs) are relatively new products in the commercial market and involve different technologies, the requirements included in this document will be reviewed as technology progresses.

4.2 Approach

It is worth emphasizing the fundamental approach of reliability qualification adopted in this document.

a) Any parts that can be effectively qualified on their individual levels shall be qualified at that level. Their qualification shall be based on IEC standards or other industrial standards in the absence of such IEC standards.

b) The qualification tests required at the DM level should be based on the degradation mechanisms and failure modes that cannot be effectively detected in the lower part levels. At the DM level, the qualification tests need not attempt to discover or identify those degradation mechanisms and failure modes that can be discovered at lower assembly levels than the final product level. For example, if all parts in the DM can be effectively tested for damp heat-accelerated degradations, there is no need to repeat the damp heat test at the DM level.

c) Specific test items for specific DMs should be considered as follows:
   – shock and vibration test for micro electro-mechanical system (MEMS) engines;
   – low temperature storage test for liquid crystal devices (LCDs) engines;

- intermittent test for LCDs and mechanical engines;
- high power test for modules which have glue and/or coating film in the optical path;
- high and low temperature operating test for thermal-optic engine;
- switching durability test for MEMS and mechanical engines.

Annex B provides guidance on reliability qualification test items and conditions.

5 Reliability qualification test items

Clause 5 defines reliability qualification test items (see Table 1). Some test items are requirements; others are optional. Table 1 shows the reliability qualification test items. The right column shows requirements (R) or optional items (O). Reliability qualification developers shall test the required items and can add tests for the optional items.

Table 1 – Reliability qualification test items

Test categories	Test items	R or O
Mechanical test	Operating mechanical shock	R
	Operating mechanical vibration	R
	Non-operating mechanical shock	R
	Non-operating mechanical vibration	R
	Non-operating unpacked drop	~~R~~O
	Non-operating packed vibration	O
	Non-operating packed drop	R
Temperature and humidity test	Non-operating high temperature	R
	Non-operating low temperature	R
	Non-operating temperature cycling	R
	Non-operating temperature shock	O
	Non-operating damp heat	R
	Operating temperature cycling	R
	Operating temperature humidity cycling	O
Electro-magnetic compatibility	Electro-magnetic compatibility	R
High optical power	Operating high optical power	R
Fibre integrity	Operating fibre pull	R
~~Key~~ ~~R: Requirement~~ ~~O: Optional~~		

Annex A
(informative)

Examples of reliability qualification test conditions

Table A.1 shows examples of reliability qualification test conditions. The reliability qualification test developer may select the condition or define other conditions by referring to Table A.1.

Table A.1 – Example of reliability qualification test conditions

Test items	Example of test conditions	Remarks
Operating mechanical shock	98 m/s^2, 0,3 ms half-sine shock pulse, 3 axes	
Operating mechanical vibration	Condition No. 1 Swept sine wave at a level of 9,8 m/s^2, 3 mm max. displacement, 5 Hz to 100 Hz, 0,1 oct/min, 3 axes Condition No. 2 Swept sine wave at a level of 19,6 m/s^2, 100 Hz to 200 Hz, 8 oct/min, 3 axes	
	Condition No. 1 Swept sine wave at a level of 9,8 m/s^2, 3 mm max. displacement, 5 Hz to 100 Hz, 0,1 oct/min, 3 axes	
Non-operating mechanical shock	2 000 m/s^2, 3 axes, 2 impacts/direction (12 impacts total), Nominal 1,33 ms, half sine pulse for 0,125 kg < m (mass) ≤ 0,225 kg	
	500 m/s^2, 3 axes, 2 impacts/direction (12 impacts total) Nominal 5 ms, half sine pulse for 0,225 kg < m ≤ 1 kg	
Non-operating unpacked drop	100 mm height for m ≤ 10 kg 75 mm height for 10 kg < m ≤ 25 kg	
Non-operating vibration	5 Hz to 50 Hz, 0,1 oct/min, 15 m/s^2, then 50 Hz to 500 Hz, 0,25 oct/min., 29,4 m/s^2	
	10 Hz to 2 000 Hz, 196 m/s^2 maximum acceleration	
Packed vibration	5 Hz to 20 Hz, 0,01 g^2/Hz, 20 Hz to 200 Hz, –3 dB/oct	
Packed drop	1 m height for ≤ 10 kg mass	
Non-operating high temperature	85 °C, 2 000 h	
Non-operating low temperature	–40 °C, 72 h	
Non-operating temperature cycling [a]	–40 °C to +70 °C, 100 cycles	
	–40 °C to +85 °C, 100 cycles	
Non-operating damp heat	85 °C, 85 % RH, 1 000 h	Telcordia GR-1312
	85 °C, 85 % RH, 500 h	
Operating temperature humidity cycling	–10 °C to +60 °C, 20 % RH to 85 % RH	
EMC	Under consideration	
Operating fibre pull	2 mm: 20 N to 100 N, 3 times, 5 s pulls 900 µm: 10 N, 3 times, 5 s pulls 250 µm: 5 N, 3 times, 5 s pulls	Test procedure: IEC 61300-2-4 Duration: Telcordia GR-1312
High optical power	Under consideration	
Sample size	Under consideration	

[a] The detail conditions of duration and temperature transition rate should be determined for consideration of thermal capacity of the DUT. The useful information of the temperature cycling test is described in IEC 60068-2-14, Test Nb.