IEC TR 62343-6-5

Edition 2.0 2014-06

TECHNICAL REPORT

colour inside

Dynamic modules –
Part 6-5: Design guide – Investigation of operating mechanical shock and vibration tests for dynamic modules

iTeh STANDARD PREVIEW
(standards.iteh.ai)
IEC TR 62343-6-5:2014
https://standards.iteh.ai/catalog/standards/sist/23c78773-821c-4844-8572-dde23d109f5d/iec-tr-62343-6-5-2014

IEC TR 62343-6-5:2014-06(en)

THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2014 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue
The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org
The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in 14 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary
More than 55 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

iTeh STANDARD PREVIEW
(standards.iteh.ai)
IEC TR 62343-6-5:2014
https://standards.iteh.ai/catalog/standard...
dde23d109f5d/iec-tr-62343-6-5-2014

IEC TR 62343-6-5

Edition 2.0 2014-06

TECHNICAL REPORT

colour inside

Dynamic modules – Part 6-5: Design guide – Investigation of operating mechanical shock and vibration tests for dynamic modules

iTeh STANDARD PREVIEW
(standards.iteh.ai)
IEC TR 62343-6-5:2014
https://standards.iteh.ai/catalog/standards/sist/23c78773-821c-4844-8572-dde23d109f5d/iec-tr-62343-6-5-2014

INTERNATIONAL ELECTROTECHNICAL COMMISSION

PRICE CODE T

ICS 33.180.20 ISBN 978-2-8322-1641-5

Warning! Make sure that you obtained this publication from an authorized distributor.

® Registered trademark of the International Electrotechnical Commission

CONTENTS

iTeh STANDARD PREVIEW
(standards.iteh.ai)
IEC TR 62343-6-5:2014
https://standards.iteh.ai/catalog/standards/sist/23c78773-821c-4844-8572-dde23d109f5d/iec-tr-62343-6-5-2014

iTeh STANDARD PREVIEW
(standards.iteh.ai)
IEC TR 62343-6-5:2014
https://standards.iteh.ai/catalog/standards/sist/23c78773-821c-4844-8572-dde23d109f5d/iec-tr-62343-6-5-2014

INTERNATIONAL ELECTROTECHNICAL COMMISSION

____

DYNAMIC MODULES –

Part 6-5: Design guide – Investigation of operating mechanical shock and vibration tests for dynamic modules

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.

iTeh STANDARD PREVIEW
(standards.iteh.ai)
IEC TR 62343-6-5:2014
https://standards.iteh.ai/catalog/standards/sist/23c78773-831b-4844-8572-dde23d109f5d/iec-tr-62343-6-5-2014

5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC 62343-6-5, which is a technical report, has been prepared by subcommittee 86C: Fibre optic systems and active devices, of IEC technical committee 86: Fibre optics.

This second edition cancels and replaces the first edition published in 2011. It constitutes technical revision.

The main change with respect to the previous edition is the addition of "Results of a questionnaire on dynamic module operating shock and vibration test conditions" in Annex A.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
86C/1206/DTR	86C/1246/RVC

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

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

A list of all parts of 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 publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

iTeh STANDARD PREVIEW
(standards.iteh.ai)
IEC TR 62343-6-5:2014
https://standards.iteh.ai/catalog/standards/sist/23e78773-821c-4844-8572-d4e23d1095d/iec-tr-62343-6-5-2014

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.

DYNAMIC MODULES –

Part 6-5: Design guide –
Investigation of operating mechanical shock and vibration tests for dynamic modules

1 Scope

This part of IEC 62343, which is a technical report, describes an investigation into operating mechanical shock and vibration for dynamic modules. It also presents the results of a survey on the evaluation and mechanical simulation of mechanical shock and vibration testing. Also included is a study of standardization for operating mechanical shock and vibration test methods.

2 Background

The recent deployment of advanced, highly flexible optical communication networks using ROADM (*reconfigurable optical add drop multiplexing*) systems has been accompanied by the practical utilization of dynamic wavelength dispersion compensators, wavelength blockers and wavelength selective switches as "dynamic modules." Since these dynamic modules incorporate such new technology as MEMS (*micro electromechanical systems*), there are concerns about the vulnerability to operating shock and vibration conditions, which urgently require establishing evaluation methods and conditions. Standards for shock and vibration test conditions pertaining to storage and transport are already established, but methods and conditions for evaluating operating shock and vibration are not yet established.

iTeh STANDARD PREVIEW
(standards.iteh.ai)
IEC TR 62343-6-5:2014
https://standards.iteh.ai/catalog/standards/sist/23c78773-821c-4844-8572-dde23d109f5d/iec-tr-62343-6-5-2014

The JIS (*Japanese Industrial Standards*) committee consequently conducted a questionnaire survey on the shock and vibration testing of passive optical components and dynamic modules in commercial use. The survey revealed that many respondents confirmed a need to standardize evaluation conditions for operating shock and vibration; some suggested earthquake, hammer impact testing and inserting an adjacent board as cases of shock and vibration during dynamic module operation. Based on the survey results, the JIS committee evaluated operating shock and vibration by conducting hammer impact tests using several dynamic modules, compared the results through simulation, and then recommended specific evaluation conditions.

This technical report is based on OITDA (Optoelectronic Industry and Technology Development Association) – TP (Technical Paper), TP05/SP_DM-2008, "Investigation on operating vibration and mechanical impact test conditions for optical modules for telecom use."

3 Questionnaire results in Japan

The JIS committee conducted a questionnaire on operating shock and vibration testing. The questionnaire allowed the respondents to specify the optical components to be tested. This questionnaire included optical switches, VOAs (*variable optical attenuators*) and tuneable filters among the mechanical components used in all possible situations. The survey covered 18 organizations: eight Japanese manufacturers of mechanical optical components, eight device makers as users of such components, and two research institutes. Reponses were received from 14 of these organizations for a response rate of 78 %, among which 12 respondents specified optical switches, seven specified VOAs and three chose tuneable filters. In tabulating the data, the survey asked questions regarding these three types of components and described occurrences not dependent on the type of component, the manufacturer and the user, and evaluation conditions.

The results revealed a strong need for the standardization of operating shock and vibration evaluation methods and conditions for such dynamic modules as optical switches and VOAs. A majority of respondents also requested that the hammer impact testing and the insertion of an adjacent PC board be included as cases of operating shock and vibration.

4 Evaluation plan

Based on the survey results described in Clause 3, the appropriate conditions for shock and vibration testing were determined based on an evaluation. The evaluation method consisted of the following three steps:

Step 1: Measure the shock and vibration characteristics of a board with a shock sensor inserted into a standard rack by striking the front face of the board with a hammer or by inserting an adjacent PC board.

Step 2: Test an optical module installed in a standard rack by repeating the procedure in Step 1. Measure any changes in the optical characteristics of the optical module.

Step 3: Use standard shock and vibration test equipment to reproduce the shock and vibration characteristics obtained in Step 1 and the optical characteristics of the optical module obtained in Step 2.

5 Evaluation results

iTeh STANDARD PREVIEW
(standards.iteh.ai)

5.1 Step 1

5.1.1 Evaluation of hammer impact

IEC TR 62343-6-5:2014
https://standards.iteh.ai/catalog/standards/sist/23e78773-821c-4844-8572-dde22d1095a/iec-tr-62343-6-5-2014

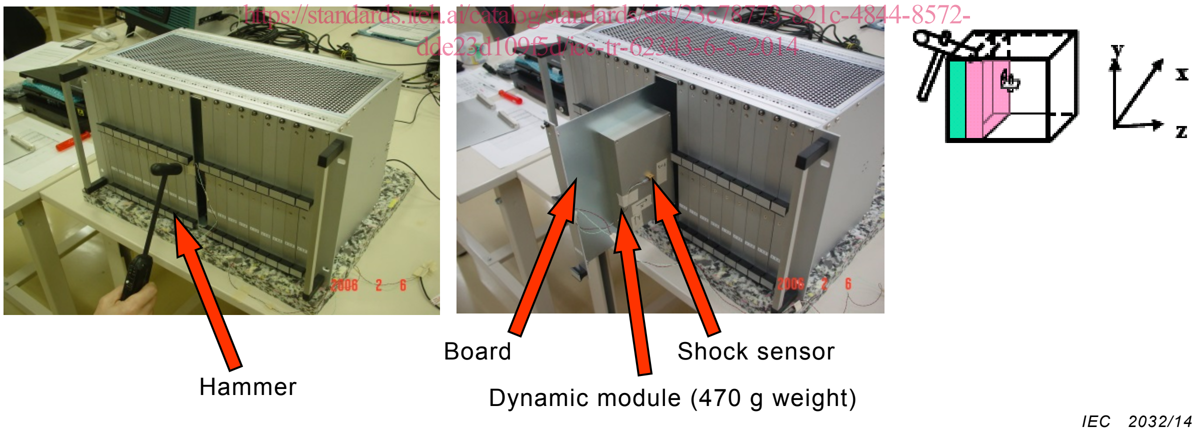

Figure 1 – Photos of evaluating hammer impact, rack and boards

A PC board with a shock sensor attached is inserted into the rack. The front of the board is then struck repeatedly by a hammer, along with an adjacent board being forcibly inserted in order to measure the impact and frequency detected by the shock sensor. The handles attached to the front edge of the rack are also forcibly struck by hand, with the impact being measured as well. Figure 1 shows photos of the hammer impact as well as the rack and PC boards. Table 1 below summarizes the specifications of the rack and PC boards, and the conditions of evaluating hammer impact and the acquisition of data.

Table 1 – Rack and board specifications, conditions of evaluating hammer impact and acquiring data

Item	Specification/Conditions
Rack size	432 mm (W) × 240 mm (D) × 262 mm (H)
Back connectors	2 pins – 96 pins
Number of PC boards	20
Striking force (acceleration intensity)	H (1 800 m/s^2 – 2 400 m/s^2) ~ 210 G M (1 200 m/s^2 – 1 600 m/s^2) ~ 140 G L (300 m/s^2 – 400 m/s^2) ~ 35 G
Places to strike	Top, middle of front panel of board
Board thickness	1,6 mm, 1,5 mm, 1,2 mm
Location of board	Centre, side
Number of boards	One, full size
Directions	x, y, z
Data acquisition	40 µs × 5 000 points (200 ms)
Sensing frequency band	10 Hz – 10 kHz

Figure 2a shows the measurement results. Here, H denotes a high level of hammer impact (at 210 G). The location of impact is at the centre of the front face of a PC board 1,6 mm thick, located at the centre of the 20 installed PC boards, with data being acquired on tests repeated 11 times. Figure 2b shows the Fourier transform results of data based on the frequency component.

iTeh STANDARD PREVIEW
(standards.iteh.ai)
IEC TR 62343-6-5:2014
https://standards.iteh.ai/catalog/standards/sist/23c78773-821e-4844-8572-dde23d1095d/iec-tr-62343-6-5-2014

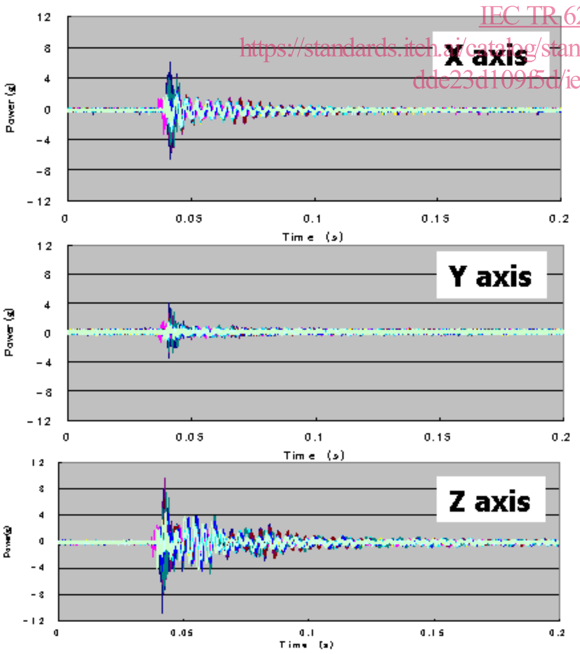

Figure 2a – Measurement results

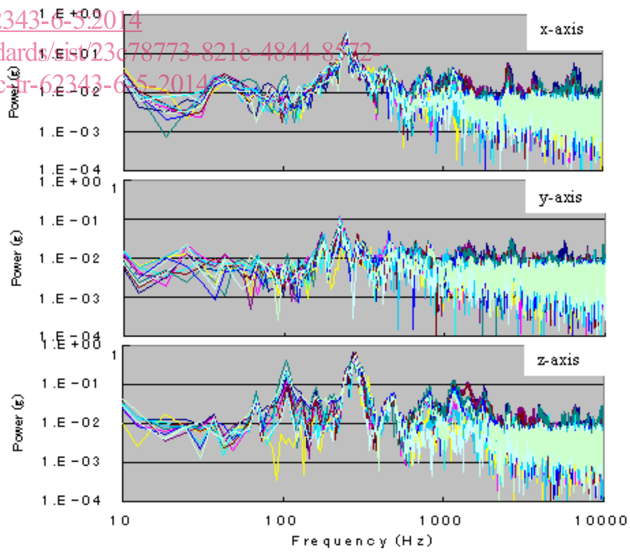

Figure 2b – Fourier transformation data

Figure 2 – Evaluation results of hammer impact H

The results show vibration time in the range of 100 ms to 200 ms, with vibration amplitude descending in order of z-axis > x-axis > y-axis. The peak shock (initial pulse) was 5 G to 10 G (in 2 ms to 5 ms). In contrast, Fourier transform results show a number of vibration peaks (at 100 Hz, 250 Hz and more than 1 kHz). The largest peak was at 220 Hz to 280 Hz. For the z-axis, the peak pulse intensity was roughly 0,5 G. Here, the strongest impact was in the z-axis, despite the fact that shock had been applied to the x-axis. This is believed to be the result of drum vibrations on the PC board. The results of hammer impacts M and L (at 2,6 G to 4 G and 0,9 G to 1,5 G, respectively) show the almost same frequency spectra and peak amplitude for the z-axis.

Next, the dependence on each evaluation condition (e.g., board thickness, board installation location, number of boards installed) was examined. The evaluation showed no significant difference in any of the evaluation conditions. Regarding the dependence on hammer impact strength, the peak shock roughly correlated to impact strength. A small peak of 70 Hz was seen in the y-axis for hammer impact L. For the dependence on board thickness, there were two peaks in the x-axis at thickness of 1,2 mm. The peak also moved slightly to the lower frequency in the z-axis. No difference could be detected in terms of location of PC board installation and board impact.

5.1.2 Evaluation of adjacent board insertion and rack handle impact

In addition to evaluating hammer impact, tests were also conducted to evaluate the insertion of an adjacent PC board and impact on the handle on the front side of the rack. Figure 3 shows photos of the evaluation tests.

iTeh STANDARD PREVIEW
(standards.iteh.ai)
IEC TR 62343-6-5:2014
https://standards.iteh.ai/catalog/standards/sist/23c78773-821c-4844-8572-dde23d109f5d/iec-tr-62343-6-5-2014

IEC 2035/14

Figure 3 – Photos of evaluating adjacent board insertion and rack handle impact

An analysis of data compared the peak amplitudes in the z-axis on the graph showing vibration attenuation before Fourier transformation. This analysis revealed that peak shock for the z-axis was 5,2 G to 6 G for the adjacent board insertion test (similar to the result for hammer impact H) and 1 G to 1,4 G for the rack handle impact test (similar to the result for hammer impact L).

An examination of data on the frequency characteristics after Fourier transformation did not reveal significant differences from the evaluation of hammer impact.

5.2 Step 2

In Step 2, a dynamic module is attached to a PC board for which the shock sensor monitors shock and vibration, identical to the approach in Step 1. At the same time, any changes in optical characteristics (loss) were monitored. Figure 4 shows photos of the PC board with the VOA and the rack with WSS (wavelength-selective switch) attached on the PC boards.