

This is a preview - click here to buy the full publication



IEC/TR 62131-2

Edition 1.0 2011-02

TECHNICAL REPORT



**Environmental conditions – Vibration and shock of electrotechnical equipment –
Part 2: Equipment transported in fixed wing jet aircraft**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE

W

ICS 19.040

ISBN 978-2-88912-383-4

CONTENTS

FOREWORD.....	4
1 Scope.....	6
2 Normative references	6
3 Data source and quality.....	7
3.1 Lockheed Tristar KC Mk 1	7
3.2 BAe VC10 K	7
3.3 Boeing 747 Combi (freight and passengers)	8
3.4 Supplementary data	10
3.4.1 McDonnell Douglas DC8 cargo	10
3.4.2 Lockheed C5A (Galaxy), Lockheed C-141 (Starlifter) and Boeing NC-135 (707).....	10
4 Intra data source comparison	10
4.1 General remark	10
4.2 Lockheed Tristar KC Mk 1	10
4.2.1 Relative severity of flight conditions.....	10
4.2.2 Position within the cargo hold	11
4.2.3 Relative severity of measurement axes.....	11
4.3 BAe VC10 K	11
4.3.1 Relative severity of flight conditions.....	11
4.3.2 Position within the cargo hold	11
4.3.3 Relative severity of measurement axes.....	12
4.4 Boeing 747 Combi (freight and passengers)	12
4.4.1 Relative severity of measurement axes.....	12
4.4.2 Relative severity of flight conditions.....	12
5 Inter data source comparison	12
6 Environmental description	13
6.1 Lockheed Tristar KC Mk 1	13
6.2 BAe VC10 K	13
6.3 Boeing 747 Combi (freight and passengers)	13
7 Supplementary data	13
7.1 McDonnell Douglas DC8 Cargo	13
7.2 Lockheed C5A (Galaxy), Lockheed C-141 (Starlifter) and Boeing NC-135 (707)	14
8 Comparison with IEC 60721	14
9 Recommendations	15
Bibliography.....	40
Figure 1 – Schematic of Tristar aircraft	17
Figure 2 – Tristar noise measurements	18
Figure 3 – Tristar vibration measurements – Take-off, power and roll	18
Figure 4 – Tristar vibration measurements – Low altitude climb	19
Figure 5 – Tristar vibration measurements – High altitude cruise	19
Figure 6 – Tristar vibration measurements – Landing.....	20
Figure 7 – Tristar vibration measurements – Low altitude decent	20
Figure 8 – Tristar vibration measurements – C of G Take-off/climb	21

Figure 9 – Tristar vibration measurements – Forward take-off/climb.....	21
Figure 10 – Tristar vibration measurements – Centre of gravity cruise	22
Figure 11 – Tristar vibration measurements – Forward cruise	22
Figure 12 – Tristar vibration measurements – Centre of gravity landing	23
Figure 13 – Tristar vibration measurements – Forward landing	23
Figure 14 – Tristar vibration measurements – Cruise environment	24
Figure 15 – Tristar vibration measurements – Take-off/landing environment	24
Figure 16 – Schematic of VC10 aircraft.....	25
Figure 17 – VC10 vibration measurements – Cruise.....	27
Figure 18 – VC10 vibration measurements – Maximum airframe severity.....	27
Figure 19 – VC10 vibration measurement – Forward container during reverse thrust	28
Figure 20 – VC10 vibration measurement – Rear container during reverse thrust	28
Figure 21 – VC10 measurements – Overlaid worst case spectra	29
Figure 22 – Vibration Measurements on a pallet in a Boeing 747 Combi aircraft (transducer V1).....	31
Figure 23 – Vibration measurements on a pallet in a Boeing 747 Combi aircraft (Transducer V2).....	31
Figure 24 – DC8 vibration measurements reverse thrust.....	32
Figure 25 – DC8 vibration measurements acceleration and take-off.....	33
Figure 26 – DC8 vibration measurements cruise	33
Figure 27 – Foley representation of environment for NC-135, C-141 and C-5A aircraft.....	34
Figure 28 – Foley landing shock environment	34
Figure 29 – Foley test severity for take-off/landing.....	35
Figure 30 – Foley test severity for cruise	36
Figure 31 – IEC 60721-3-2 (1997) – Stationary vibration random	37
Figure 32 – IEC 60721-3-2 (1997) – Non-stationary vibration including shock.....	37
Figure 33 – Test severities – ASTM D 4728-91	38
Figure 34 – Test severities – Mil Std 810 issue F and G.....	38
Figure 35 – Test severities – AECTP 400 (Edition 2 & 3)	39
Figure 36 – Test severity – Def Stan 00-35, issue 3 & 4.....	39
Table 1 – Tristar flight conditions and measured r.m.s. values	17
Table 2 – VC10 flight conditions	25
Table 2a – VC10 measurement locations	25
Table 3 – Overall g r.m.s. (3,25 Hz to 2 000 Hz) for VC10 airframe/container	26
Table 4 – Overall g r.m.s. (3,25 Hz to 399 Hz) for VC 10 container measurements	26
Table 5 – Summary of 747 air transport data	30
Table 6 – Summary of 747 acceleration levels (g) expected to be exceeded for 1 % of the time of the trial.....	30
Table 7 – Summary of DC8 air data	32
Table 8 – Foley test severity for take-off/landing – Sine components	35
Table 9 – Foley test severity for cruise – Sine components.....	36

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ENVIRONMENTAL CONDITIONS – VIBRATION AND SHOCK OF ELECTROTECHNICAL EQUIPMENT –

Part 2: Equipment transported in fixed wing jet aircraft

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.
- 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/TR 62131-2, which is a technical report, has been prepared by IEC technical committee 104: Environmental conditions, classification and methods of test.

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

Enquiry draft	Report on voting
104/507/DTR	104/536/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 the parts in the IEC 62131 series, under the general title *Environmental conditions – Vibration and shock of electrotechnical equipment*, 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 standard may be issued at a later date.

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.

ENVIRONMENTAL CONDITIONS – VIBRATION AND SHOCK OF ELECTROTECHNICAL EQUIPMENT –

Part 2: Equipment transported in fixed wing jet aircraft

1 Scope

IEC/TR 62131-2, which is a technical report, reviews the available dynamic data relating to electrotechnical equipment transported in fixed wing jet transport aircraft. The intent is that from all the available data an environmental description will be generated and compared to that set out in IEC 60721.

For each of the sources identified the quality of the data is reviewed and checked for self consistency. The process used to undertake this check of data quality and that used to intrinsically categorize the various data sources is set out in IEC/TR 62131-1.

This technical report primarily addresses data extracted from a number of different sources for which reasonable confidence exist as to their quality and validity. The report also presents data for which the quality and validity cannot realistically be reviewed. These data are included to facilitate validation of information from other sources. The report clearly indicates when it utilizes information in this latter category.

This technical report addresses data from several different transport aircraft¹. Although one of these aircraft is no longer used commercially, data from it are included to facilitate validation of information from other sources.

Relatively little of the data reviewed has been made available in electronic form. To permit comparison, a quantity of the original (non-electronic) data have been manually digitized in this technical report.

2 Normative references

The following referenced documents are indispensable for the application 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 60721 (all parts), *Classification of environmental conditions*

IEC 60721-3-2:1997, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 2: Transportation*

¹ Lockheed Tristar KC Mk 1, Lockheed Tristar L-1011, BAe VC10 K, Boeing 747 Combi, McDonnell Douglas DC8 Cargo, Lockheed C5A (Galaxy), Lockheed C-141 (Starlifter), Boeing NC-135 (707) are the trade names of products supplied by Lockheed, BAe, McDonnell Douglas and Boeing, respectively. This information is given for the convenience of users of this technical report and does not constitute an endorsement by IEC of the products named.