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Interested committees:

Title: BS EN IEC 60068-2-64 Environmental testing

Part 2-64: Tests - Test Fh: Vibration, broadband random and guidance

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



104/1090/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER: IEC 60068-2-64 ED3	
DATE OF CIRCULATION: 2025-01-10	CLOSING DATE FOR COMMENTS: 2025-03-07
SUPERSEDES DOCUMENTS: 104/1087/RR	

IEC TC 104 : ENVIRONMENTAL CONDITIONS, CLASSIFICATION AND METHODS OF TEST	
SECRETARIAT: Sweden	SECRETARY: Mr Joakim Grafström
OF INTEREST TO THE FOLLOWING COMMITTEES: TC 9,TC 17,SC 17C,TC 21,TC 23,SC 23E,TC 40,TC 45,SC 45B,TC 48,SC 48D,TC 49,TC 61,TC 62,SC 62A,TC 65,SC 65B,TC 82,TC 86,SC 86B,TC 94,TC 105	HORIZONTAL FUNCTION(S): TC 104 Horizontal Basic Safety
ASPECTS CONCERNED: Safety	

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TITLE:

Environmental testing - Part 2-64: Tests - Test Fh: Vibration, broadband random and guidance

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ENVIRONMENTAL TESTING –

**Part 2-64: Tests – Test Fh: Vibration,
broadband random and guidance**

FOREWORD

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International Standard IEC 60068-2-64 has been prepared by IEC technical committee 104: Environmental conditions, classification and methods of test.

This third edition cancels and replaces the second edition, published in ???, and constitutes a technical revision.

The major changes with regard to the previous edition concern the update of Annex A with references to examples, the introduction of an organizational deviation treatment and some clarification on requirements.

139 The text of this standard is based on the following documents:

FDIS	Report on voting

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

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

143 It has the status of a basic safety publication in accordance with IEC Guide 104.

144 A list of all the parts in the IEC 60068 series, under the general title *Environmental testing*, can
145 be found on the IEC website.

146 The committee has decided that the contents of this publication will remain unchanged until the
147 maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data
148 related to the specific publication. At this date, the publication will be

- 149 • reconfirmed,
150 • withdrawn,
151 • replaced by a revised edition, or
152 • amended.

153

154

155

INTRODUCTION

156 This part of IEC 60068 deals with broadband random vibration testing intended for general
157 application to components, equipment and other products, hereinafter referred to as specimens,
158 that may be subjected to vibrations of a stochastic nature. The methods and techniques in this
159 standard are based on digital control of random vibration. It permits the introduction of variations
160 to suit individual cases if these are prescribed by the relevant specification.

161 Compared with most other vibration tests, test Fh is not based on deterministic but on statistical
162 techniques. Broad-band random vibration testing is therefore described in terms of probability
163 and statistical averages.

164 It is emphasized that random testing always demands a certain degree of engineering
165 judgement, and both equipment supplier and purchaser as well as the test house should be
166 fully aware of this fact. The writer of the relevant specification is expected to select the testing
167 procedure and the values of severity appropriate to the specimen and its use.

168 The test method is based primarily on the use of an electrodynamic or a servo-hydraulic
169 vibration generator with an associated computer based control system relying on measurement
170 sensors used as a vibration testing system.

171 The traditional general purpose broad-band random vibration test utilizes waveforms with a
172 Gaussian distribution of amplitudes. However, when so specified, this test procedure can also
173 be utilized with random vibration tests with a non-Gaussian distribution of amplitudes. Such
174 tests are sometimes alternatively known as high kurtosis tests.

175 Annexes A and B are informative annexes giving reference to examples of test spectra for
176 different environmental conditions and a list of details to be considered for inclusion in
177 specifications and guidance.

178 Annex C is an informative annex giving information on non-Gaussian distribution/high kurtosis
179 tests.

180 Annex D is an informative annex giving guidance on technical measures of verification that the
181 intended test purpose is achieved by the test.

182

ENVIRONMENTAL TESTING –

Part 2-64: Tests-Test Fh: Vibration, broadband random and guidance

1 Scope

This part of IEC 60068 demonstrates the adequacy of specimens to resist dynamic loads without unacceptable degradation of its functional and/or structural integrity when subjected to the specified random vibration test requirements.

Broadband random vibration may be used to identify accumulated stress effects and the resulting mechanical weakness and degradation in the specified performance. This information, in conjunction with the relevant specification, may be used to assess the acceptability of specimens.

This document is applicable to specimens which may be subjected to vibration of a stochastic nature resulting from transportation or operational environments, for example in aircraft, space vehicles and land vehicles. It is primarily intended for unpackaged specimens, and for items in their transportation container when the latter may be considered as part of the specimen itself. However, if the item is packaged, then the item itself is referred to as a product and the item and its packaging together are referred to as a test specimen. This standard document may be used in conjunction with IEC 60068-2-47:2005, for testing packaged products.

If the specimens are subjected to vibration of a combination of random and deterministic nature resulting from transportation or real life environments, for example in aircraft, space vehicles and for items in their transportation container, testing with pure random may not be sufficient. See IEC 60068-3-8:2003 for estimating the dynamic vibration environment of the specimen and based on that, selecting the appropriate test method.

Although primarily intended for electrotechnical specimens, this standard is not restricted to them and may be used in other fields where desired (see 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 60050-300: *International Electrotechnical Vocabulary – Electrical and electronic measurements and measuring instruments – Part 311: General terms relating to measurements – Part 312: General terms relating to electrical measurements – Part 313: Types of electrical measuring instruments – Part 314: Specific terms according to the type of instrument*

IEC 60068-1: *Environmental testing – Part 1: General and guidance*

IEC 60068-2-6: *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-47:2005, *Environmental testing – Part 2-47: Tests – Mounting of specimens for vibration, impact and similar dynamic tests*

IEC 60068-3-8:2003, *Environmental testing – Part 3-8: Supporting documentation and guidance – Selecting amongst vibration tests*

227 IEC 60068-5-2: *Environmental testing – Part 5-2: Guide to drafting of test methods – Terms and*
228 *definitions*

229 IEC Guide 104, The preparation of safety publications and the use of basic safety publications
230 and group safety publications

231 **3 Terms and definitions**

232 For the purposes of this document, the following terms and definitions apply.

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

235 – • IEC Electropedia: available at <http://www.electropedia.org/>

236 – • ISO Online browsing platform: available at <http://www.iso.org/obp>

237 NOTE The terms used are generally defined in IEC 60050-300, IEC 60068-1, IEC 60068-2-6, and IEC 60068-5-2
238 and ISO 2041. If a definition from one of those sources is included here, the derivation is indicated and departures
239 from the definitions in those sources are also indicated.

240 **3.1**

241 **cross-axis motion**

242 motion not in the direction of the stimulus; generally specified in the two axes orthogonal to the
243 direction of the stimulus

244 NOTE The cross-axis motion should be measured close to the fixing points.

245 **3.2**

246 **actual motion**

247 motion represented by the wideband signal returned from the reference point transducer

248 **3.3**

249 **fixing point**

250 part of the specimen in contact with the fixture or vibration table at a point where the specimen
251 is normally fastened in service

252 NOTE If a part of the real mounting structure is used as the fixture, the fixing points are taken as those of the
253 mounting structure and not of the specimen.

254 NOTE 2 Where the specimen consists of a packaged product, fixing point may be interpreted
255 as the surface of the specimen which is in contact with the vibration table.

256

257 **3.4**

258 **control methods**

259 **3.4.1**

260 **single point control**

261 control method using the signal from the transducer at the reference point in order to maintain
262 this point at the specified vibration level

263 **3.4.2**

264 **multipoint control**

265 control method using the signals from each of the transducers at the checkpoints

266 NOTE The signals are either continuously averaged arithmetically or processed by using comparison techniques,
267 depending upon the relevant specification. See also 3.13.

268 **3.5**
269 **g_n**
270 standard acceleration due to the earth's gravity, which itself varies with altitude and
271 geographical latitude

272 NOTE For the purposes of this standard, the value of g_n is rounded up to the nearest whole number, that is 10 m/s².

273 **3.6**
274 **measuring points**
275 specific points at which data are gathered for conducting the test

276 NOTE These points are of three types, as defined in 3.7 to 3.9.

277 **3.7**
278 **checkpoint**
279 point located on the fixture, on the vibration table or on the specimen as close as possible to
280 one of its fixing points, and in any case, rigidly connected to it

281 NOTE 1 A number of checkpoints are used as a means of ensuring that the test requirements are satisfied.

282 NOTE 2 If four or fewer fixing points exist, each is used as a checkpoint. For packaged products, where a fixing
283 point may be interpreted as the packaging surface in contact with the vibration table, one checkpoint may be used,
284 provided that there are no effects due to resonances of the vibration table or the mounting structure in the frequency
285 range specified for the test. If this is the case, multipoint control may be recommended, but see also NOTE 3. If more
286 than four fixing points exist, four representative fixing points will be defined in the relevant specification to be used
287 as checkpoints.

288 NOTE 3 In special cases, for example for large or complex specimens, the checkpoints will be prescribed by the
289 relevant specification if not close to the fixing points.

290 NOTE 4 Where a large number of small specimens are mounted on one fixture, or in the case of a small specimen
291 with a number of fixing points, a single checkpoint (that is the reference point) may be selected for the derivation of
292 the control signal. This signal is then related to the fixture rather than to the fixing points of the specimen(s). This
293 procedure is only valid when the lowest resonance frequency of the loaded fixture is well above the upper frequency
294 of the test.

295 **3.8**
296 **reference point (single-point control)**
297 point, chosen from amongst the checkpoints, whose signal is used to control the test, such that
298 the requirements of this standard are satisfied

299 **3.9**
300 **fictitious reference point (multipoint control)**
301 point, derived from multiple checkpoints either manually or automatically, the result of which is
302 used to control the test so that the requirements of this standard are satisfied

303 **3.10**
304 **response points**
305 specific points on the specimen from which data is gathered for the purpose of the vibration
306 response investigation

307 NOTE These points are not the same as checkpoints or reference points.

308 **3.11**
309 **preferred testing axes**
310 three (usually) orthogonal axes that correspond to the most vulnerable axes of the specimen.

311 NOTE. The selection of the preferred testing axes may be depending on the specimen's design and the sub-
312 components inside, may not always be orthogonal; the in-service mounting orientation of the specimen may also play
313 a role in the selection of the preferred testing axes

314 **3.12**
315 **sampling frequency**
316 number of discrete magnitude values taken per second to record or represent a time-history in
317 a digital form

318 **3.13**
319 **multipoint control strategies**
320 method for calculating the reference control signal when using multipoint control

321 NOTE Different frequency domain control strategies are discussed to in 4.7.1.

322 **3.14**
323 **averaging**
324 process of determining the control acceleration spectral density formed from the arithmetic
325 average of the acceleration spectral densities at each frequency line of more than one
326 checkpoint

327 **3.15**
328 **extremal (maximum or minimum)**
329 process of determining the control acceleration spectral density formed from the maximum or
330 minimum acceleration spectral density at each frequency line of more than one checkpoint

331 **3.16**
332 **crest factor**
333 ratio of the peak value to the r.m.s. value of the time history.

334 [ISO 2041]

335 **3.17**
336 **−3 dB bandwidth**
337 frequency bandwidth between two points in a frequency response function which are at 0,707
338 of the maximum response when associated with a single resonance peak. Can be applied to
339 power or field dimensions but chosen dimension is to be given.

340 **3.18**
341 **acceleration spectral density**
342 ASD
343 mean-square value of that part of an acceleration signal passed by a narrow-band filter of a
344 centre frequency, per unit bandwidth, in the limit as the bandwidth approaches zero and the
345 averaging time approaches infinity

346 **3.19**
347 **control acceleration spectral density**
348 acceleration spectral density measured at the reference point or the fictitious reference point

349 **3.20**
350 **control system loop**
351 sum of the following actions:

- 352 – digitizing the analogue waveform of the signal derived from the reference point or
353 fictitious reference point;
- 354 – performing the necessary processing;
- 355 – producing an updated analogue drive waveform to the vibration system power amplifier
356 (see Clause B.1.)

357 NOTE Subsystems in the control system loop and steps in the signal processing chain may be:

- 358 - Transducer (measurement instrument transferring the physical quantity to be measured – usually kinetic
359 like acceleration – to an electric signal), feeding to
- 360 - Signal conditioning - may be included in controller (power supply, AC-coupling) or the transducer (charge
361 amplifier), feeding to
- 362 - Controller (producing a defined output signal to achieve a certain wanted vibration environment), feeding
363 drive signal to
- 364 - Power amplifier (including further control loops and signal processing), feeding to
- 365 - Shaker (transfer from electric actuation power to mechanical movement and force), movement measurement
366 by transducer

367 3.21

368 drive signal clipping

369 limitation of the maximum crest factor imposed on the drive signal within the effective frequency
370 range. It describes the process to apply the required Crest Factor (3.16) to the drive signal(s)
371 produced by the digital control system

372 3.22

373 effective frequency range (see also Figure 1)

374 frequency range of measurement and control between 0,5 times f_1 and 2,0 times f_2 of the test
375 frequency range

376 NOTE Due to initial and final slope, the effective frequency range is higher than the test frequency range between
377 f_1 and f_2 .

378 3.23

379 error acceleration spectral density

380 difference between the specified acceleration spectral density and the control acceleration
381 spectral density

382 3.24

383 equalization

384 minimization of the error acceleration spectral density

385 3.25

386 final slope (see also Figure 1)

387 part of the specified acceleration spectral density above f_2

388 3.26

389 frequency resolution

390 B_e

391 width of the frequency intervals in the acceleration spectral density in Hertz

392 NOTE It is equal to the reciprocal of the record block length (T) in digital analysis; the number of frequency lines is
393 equal to the number of intervals in a given frequency range

394 3.27

395 indicated acceleration spectral density

396 estimate of the true acceleration spectral density read from the analyser presentation distorted
397 by the instrument error and the random error

398 3.28

399 initial slope (see also Figure 1)

400 part of the specified acceleration spectral density below f_1

401 **3.29**
402 **instrument error**
403 error associated with each analogue item of the input to the control system and control system
404 analogue items

405 **3.30**
406 **random error**
407 error changing from one estimate to another of the acceleration spectral density because of the
408 limitation of averaging time and filter bandwidth in practice; with an infinite averaging time the
409 error would converge towards zero

410 **3.31**
411 **record**
412 collection of equally spaced data points in the time domain that are used in the calculation of
413 the Fast Fourier Transform

414 **3.32**
415 **reproducibility**
416 closeness of the agreement between the results of measurements of the same value of the
417 same quantity, where the individual measurements are made

- 418 – by different methods,
- 419 – with different measuring instruments,
- 420 – with different signal generation
- 421 – by different observers,
- 422 – in different laboratories,
- 423 – after intervals of time which are long compared with the duration of a single
- 424 measurement,
- 425 – under different customary conditions of use of the instruments employed

426 NOTE The term “reproducible” also applies to the case where only certain of the preceding conditions are taken
427 into account.

428 [IEC 60050-300, modified]

429 **3.33**
430 **root-mean-square value** (see also Figure 2)
431 root-mean-square value (r.m.s. value) of a single-valued function over an interval between two
432 frequencies is the square root of the average of the squared values of all functions over the
433 total frequency interval f_1 and f_2

434 **3.34**
435 **standard deviation, σ** (see also Figure 2)
436 The root-mean-square(r.m.s) value of the deviation of a random time history from a mean value.
437 in vibration theory, the mean value of vibration is equal to zero; therefore, for a random time
438 history, the standard deviation is equal to the r.m.s. value. For non-gaussian distribution see
439 Annex C.

440 **3.35**
441 **statistical accuracy**
442 ratio of true acceleration spectral density to indicated acceleration spectral density