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Elektroakustične naprave - 4. del: Mikrofoni

Sound system equipment - Part 4: Microphones

Elektroakustische Geräte - Teil 4: Mikrofone

Equipements pour systèmes électroacoustiques - Partie 4: Microphones

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TITLE:

Sound system equipment - Part 4: Microphones

NOTE FROM TC/SC OFFICERS:

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

SOUND SYSTEM EQUIPMENT –

Part 4: Microphones

FOREWORD

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216 International Standard IEC 60268-4 has been prepared by IEC technical committee 100:
217 Audio, video and multimedia systems and equipment.

218 This sixth edition cancels and replaces the fifth edition published in 2014, and constitutes a
219 technical revision.

220 This edition includes the following significant technical changes with respect to the previous
221 edition:

- 222 – Pop measurement replaced by former Annex
- 223 – new Annex D for noise measurements in digital domain

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

CDV	Report on voting

225
226 Full information on the voting for the approval of this standard can be found in the report on
227 voting indicated in the above table.

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

229 A list of all parts of the IEC 60268 series, under the general title *Sound system equipment*,
230 can be found on the IEC website.

231 The committee has decided that the contents of this publication will remain unchanged until
232 the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data
233 related to the specific publication. At this date, the publication will be

- 234 • reconfirmed,
235 • withdrawn,
236 • replaced by a revised edition, or
237 • amended.

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SOUND SYSTEM EQUIPMENT –

Part 4: Microphones

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247 **1 Scope**

248 This part of IEC 60268 specifies methods of measurement for the electrical impedance,
249 sensitivity, directional response pattern, dynamic range and external influences of sound
250 system microphones, and also details the characteristics to be specified by the manufacturer.

251 It applies to sound system microphones for all applications for speech and music. It does not
252 apply to measurement microphones, but it does apply to each audio channel of microphones
253 having more than one channel, for example for stereo or similar use. It is also applicable to
254 flush-mounted microphones and to the analogue characteristics of microphones with digital
255 audio output.

256 For the purposes of this International Standard, a microphone includes all such devices as
257 transformers, pre-amplifiers, or other elements that form an integral part of the microphone,
258 up to the output terminals specified by the manufacturer.

259 The major characteristics of a microphone are considered in Clauses 6 to 21. Additional
260 characteristics are considered in Annex A and Annex C.

261 NOTE The characteristics specified in this standard do not describe the subjective response of the microphone.
262 Further work is necessary to find new definitions and measurement procedures for a later introduction of objective
263 characteristics for at least some of the subjective descriptions used to describe microphone performance.

264 **2 Normative references**

265 The following documents, in whole or in part, are normatively referenced in this document and
266 are indispensable for its application. For dated references, only the edition cited applies. For
267 undated references, the latest edition of the referenced document (including any
268 amendments) applies.

269 CISPR 35:2016, *Electromagnetic compatibility of multimedia equipment – Immunity*
270 *requirements*

271 IEC 60268-1:1985, *Sound system equipment – Part 1: General*
272 *Amendment 1:1988*
273 *Amendment 2:1988*

274 IEC 60268-2:1987, *Sound system equipment – Part 2: Explanation of general terms and*
275 *calculation methods*
276 *Amendment 1:1991*

277 IEC 60268-3:2013, *Sound system equipment – Part 3: Amplifiers*

278 IEC 60268-5:2003, *Sound system equipment – Part 5: Loudspeakers*
279 *Amendment 1:2007*

280 IEC 60268-11:1987, *Sound system equipment – Part 11: Application of connectors for the*
281 *interconnection of sound system components*
282 *Amendment 1:1989*
283 *Amendment 2:1991*

- 284 IEC 60268-12:1987, *Sound system equipment – Part 12: Application of connectors for*
 285 *broadcast and similar use*
 286 Amendment 1:1991
 287 Amendment 2:1994
- 288 IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and*
 289 *measurement techniques – Electrostatic discharge immunity test*
- 290 IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and*
 291 *measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test*
 292 Amendment 1:2007
 293 Amendment 2:2010
- 294 IEC 61000-4-4:2012, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and*
 295 *measurement techniques – Electrical fast transient/burst immunity test*
- 296 IEC 61000-4-6:2013, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and*
 297 *measurement techniques – Immunity to conducted disturbances, induced by radio-frequency*
 298 *fields*
- 299 IEC 61000-4-8:2009, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and*
 300 *measurement techniques – Power frequency magnetic field immunity test*
- 301 IEC 61000-4-16:2015, *Electromagnetic compatibility (EMC) – Part 4-16: Testing and*
 302 *measurement techniques – Test for immunity to conducted, common mode disturbances in*
 303 *the frequency range 0 Hz to 150 kHz*
- 304 IEC 61000-4-17:1999, *Electromagnetic compatibility (EMC) – Part 4-17: Testing and*
 305 *measurement techniques - Ripple on d.c. input power port immunity test*
 306 Amendment 1:2001
 307 Amendment 2:2008
- 308 IEC 61260-1:2014, *Electroacoustics – Octave-band and fractional-octave-band filters –*
 309 *Part 1: Specifications*
- 310 IEC 61938:2013, *Multimedia systems – Guide to the recommended characteristics of*
 311 *analogue interfaces to achieve interoperability*
- 312 ITU-T Recommendation P.51:1996, *Artificial mouth*
- 313 EN 55103-2:2009, *Electromagnetic compatibility – Product family standard for audio, video,*
 314 *audio-visual and entertainment lighting control apparatus for professional use – Part 2:*
 315 *Immunity*
- 316 EN 300 422-2 V1.3.1:2011, *Electromagnetic compatibility and radio spectrum matters (ERM)*
 317 *– Wireless microphones in the 25 MHz to 3 GHz frequency range – Part 2: Harmonized EN*
 318 *covering the essential requirements of article 3.2 of the R&TTE Directive*

319 **3 Terms and definitions**

320 For the purposes of this document, the terms and definitions given in IEC 60268-1 and the
 321 following apply.

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

- 324 • IEC Electropedia: available at <http://www.electropedia.org/>

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

326

327 **3.1 far-field microphone**

328 microphone for use mainly at a distance of 1 m or more from the source of sound

329 **3.2 near-field microphone**

330 microphone for use by an individual performer at a distance of approximately 30 cm

331 **3.3 close-talking microphone**

332 microphone for use at a distance of approximately 25 mm from the source of sound

333 NOTE 1 to 3.1-3.3: The three terms "far-field microphone, near-field microphone and close-talking microphone"
334 describe microphone applications (see 6.4) and not types of microphone. A specific microphone may have one or
335 more applications, but the terms are helpful in specifying the methods of measurement.

336 **4 General conditions**

337 **4.1 General**

338 Special reference is made to IEC 60268-1, concerning:

- 339 • units and system of measurement;
- 340 • frequencies of measurement;
- 341 • quantities to be specified and their accuracy (see also 5.7);
- 342 • marking (see also 7.1);
- 343 • ambient conditions;
- 344 • filters, networks and measuring instruments for noise specification and measurement;
- 345 • individual specifications and type specifications;
- 346 • graphical presentation of characteristics;
- 347 • scales for graphical presentation;
- 348 • personal safety and prevention of spread of fire;
- 349 • method of producing a uniform alternating magnetic field;
- 350 • search coils for measuring the magnetic field strength,

351 and to IEC 61938 concerning powering of microphones.

352 **4.2 Measurement conditions**

353 **4.2.1 General**

354 For convenience in specifying how microphones shall be set up for measurement, three sets
355 of conditions have been defined in this standard, under the title of "rated conditions".

356 Microphones should be measured in conditions approximating those in which they are
357 intended to be used. Three sets of measurement conditions are specified in this standard:
358 free-field, near-field and close-talking. The differences between these sets of conditions are in
359 the distance to the sound source and the sound pressure level of the measurement.
360 Measurements shall be reported using at least one of these sets of conditions. Additional data
361 may be included, provided that the measurement conditions are specified.

362 Three ratings are basic to the formulation of these concepts:

- 363 – rated power supply (see 9.1);
- 364 – rated impedance (see 10.2);
- 365 – rated sensitivity (see 11.3).

366 To obtain the correct conditions for measurement, the above mentioned ratings shall be taken
367 from the specifications supplied by the manufacturer of the equipment.

368 The term "rated" applied to other characteristics relates to the specification or measurement
369 of the particular characteristic under rated conditions or under conditions unambiguously
370 connected to them. This applies, for example, to the following two characteristics:

- 371 – rated output voltage;
- 372 – rated equivalent sound pressure level due to inherent noise.

373 Methods of measurement are given in this standard for electrical impedance, sensitivity,
374 directional pattern, dynamic range and external influences. Where alternative methods are
375 given, the chosen method shall be specified.

376 **4.2.2 Rated conditions**

377 The microphone is understood to be working under rated conditions when the following
378 conditions are fulfilled:

- 379 – the microphone is connected to the resistive load specified in 5.4, or as specified by the
380 manufacturer;
- 381 – if the microphone needs a power supply, this is the rated power supply;
- 382 – the microphone (except a close-talking or near-field microphone) is placed in a sound field
383 meeting the free-field conditions in 5.5.2, the waves having zero degree incidence with
384 respect to the reference direction;
- 385 – far-field microphones shall be measured in free-field conditions;
- 386 – the undisturbed sound pressure (in the absence of the microphone) in the sound field at
387 the reference point of the microphone is sinusoidal and set at a level of 1 Pa (94 dB SPL);
- 388 – for close-talking microphones, the microphone is placed at a stated distance, no more
389 than 25 mm from the artificial mouth complying with ITU-T Recommendation P.51, and the
390 undisturbed sound pressure in the sound field at the reference point of microphone is
391 sinusoidal and set at a level of 3 Pa (104 dB SPL);
- 392 – for near-field microphones, the microphone is placed at 30 cm from the artificial mouth
393 complying with ITU-T Recommendation P.51, and the undisturbed sound pressure in the
394 sound field at the reference point of microphone is sinusoidal and set at a level of 1 Pa
395 (94 dB SPL);
- 396 – if a special microphone needs a different measurement level or procedure (e.g. Lavalier or
397 boundary layer microphones), it shall be stated in the technical data together with the
398 reason for this. Levels related to the normal reference level of 94 dB by multiples of 10 dB
399 are preferred;
- 400 – controls, if any, are set to the position recommended by the manufacturer;
- 401 – in the absence of a clear reason to the contrary, the measurement frequency is 1 000 Hz
402 (see IEC 60268-1);
- 403 – the ambient pressure, relative humidity and ambient temperature are within the limits
404 given in IEC 60268-1, and shall be stated.

405 Measurements may be made at a sound pressure of 0,3 Pa if this is necessary due to
406 limitations of the performance of the loudspeaker or other measurement equipment, and only
407 if any change in performance between the level used and the reference level is known with
408 the necessary accuracy for the relevant characteristics.

409 5 Particular conditions

410 5.1 Pre-conditioning

411 A microphone with preamplifier shall be switched on for the period of time specified by the
412 manufacturer, before measurements are made, to allow the components to reach the
413 stationary temperature for rated conditions. If the manufacturer specifies no period, a period
414 of 10 s shall be allowed for stabilization. If the microphone contains a vacuum tube or other
415 heating device the time shall be 10 min.

416 5.2 Sound source

417 The sound source shall be capable of producing at the microphone position the sound
418 pressure level as defined for rated conditions. The amplitude non-linearity of the sound
419 source shall be held to such a value that the effect on the measured response does not
420 exceed 0,5 dB. If the conditions of measurement preclude the possibility of securing
421 sufficiently low distortion, a narrow-band filter may be used at the microphone output
422 terminals, which allows the response at the fundamental frequency to be measured.

423 For free-field calibration and calibration of near-field microphones, the sound source shall be
424 contained in an enclosure which radiates sound from one well-defined opening fulfilling the
425 sound field requirements, preferably by only one being radially symmetrical with respect to the
426 axis of the reference direction of the microphone.

427 5.3 Measurement of sound pressure

428 A calibrated reference pressure microphone shall be used to measure the sound pressure.
429 The reference microphone shall be calibrated with an accuracy of ± 1 dB at 1k Hz or better.

430 5.4 Voltage measuring system

431 The voltage generated by the microphone, when in a sound field, shall be determined by
432 using a voltmeter with an input resistance negligible to the specified microphone load. This
433 load is five times the rated impedance of the microphone, unless otherwise stated by the
434 manufacturer. If external equipment, such as a power supply, applies an impedance in
435 parallel with the microphone, its impedance shall be taken into account.

436 NOTE Microphones having a rated impedance of 200 Ω often have an actual internal impedance in the order of
437 50 Ω , and many of them perform best with a minimum load impedance around 1 000 Ω .

438 5.5 Acoustical environment

439 5.5.1 General

440 The microphone can be measured in different acoustical environments:

- 441 a) in a free field or similar with negligible boundary effects, e.g. by using special computer-
442 generated sound source signals:
- 443 – spherical waves, or
 - 444 – plane waves, or
 - 445 – waves produced by a specific sound source (artificial mouth or artificial head);
- 446 b) in a diffuse field;
- 447 c) coupled to a sound source by means of a small cavity (coupler).

448 5.5.2 Free-field conditions

449 5.5.2.1 General

450 A free-field sound wave is normally divergent in character. In certain circumstances it can
451 approximate an ideal plane wave. Free-field conditions can be obtained:

- 452 – in open air, ambient noise and wind permitting, or
- 453 – in an anechoic room, or
- 454 – in a duct.

455 A sound source of small dimensions with respect to the wavelength produces a spherical
456 wave in these environments. The spherical wave can be approximated to a plane wave in a
457 region of measurement located at a sufficient distance from the source. Spherical waves can
458 be used to measure pressure microphones but it is necessary to use almost perfect plane
459 waves in the low-frequency range for the measurement of pressure gradient microphones.

460 For microphones responding both to pressure and to pressure gradient, having a sufficiently
461 flat frequency response in a plane-wave free sound field (i.e. at a sufficient distance from the
462 source), the response as a function of frequency f of distance r from a centre of spherical
463 diverging waves and of angle of incidence θ of the waves at the microphone, can be given in
464 a complex form:

$$465 \quad (1 - B) + B \left(1 + \frac{1}{jkr} \right) \cos \theta$$

466 where

467 $1 - B$ is the contribution of the pressure component;

468 B is the contribution of the pressure gradient component;

469 $k = 2\pi/\lambda$ or $2\pi f/c$ (λ - wavelength, c - speed of sound);

470 $B = 0$ for the omnidirectional pressure type;

471 $B = 0,5$ for the cardioid type;

472 $B = 1$ for the bidirectional pressure gradient type.

473 At low frequencies, it becomes difficult to realize plane wave conditions in an anechoic room.
474 A plane wave at low frequencies, below the cut-off frequency of the anechoic room, can
475 therefore be better produced under other conditions.

476 Free-field conditions are considered to be sufficiently realized in the region around the
477 microphone if the following conditions are met:

- 478 – within a distance of 200 mm in front, behind, right, left, above and below the position of
479 the microphone the sound pressure level is measured at every measuring frequency by
480 means of a pressure transducer;
- 481 – the axis of the transducer shall point towards the reference point of the loudspeaker (see
482 IEC 60268-5);
- 483 – the corresponding sound pressure levels on axis positioned at different distances from the
484 loudspeaker shall not differ by more than 0,5 dB from the calculated levels in the ideal
485 sound field;
- 486 – the values at a nearly constant distance to the sound source, right, left, above and below
487 the microphone shall not differ by more than 1 dB from the level at the reference point of
488 the microphone.