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Tehnike visokonapetostnega preskušanja - 2. del: Merilni sistemi

High-voltage test techniques - Part 2: Measuring systems

Hochspannungs-Prüftechnik - Teil 2: Messsysteme

Techniques des essais à haute tension - Partie 2: Systèmes de mesure

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FUNCTIONS CONCERNED: <input type="checkbox"/> EMC <input type="checkbox"/> ENVIRONMENT <input type="checkbox"/> QUALITY ASSURANCE <input type="checkbox"/> SAFETY	
<input checked="" type="checkbox"/> SUBMITTED FOR CENELEC PARALLEL VOTING Attention IEC-CENELEC parallel voting The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting. The CENELEC members are invited to vote through the CENELEC online voting system.	<input type="checkbox"/> NOT SUBMITTED FOR CENELEC PARALLEL VOTING

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TITLE:

High-voltage test techniques - Part 2: Measuring systems

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195 Introduction relevant for CD only

196 A sweeping review has been made on usage of “may” incorrectly being used as indication of
197 possibility: The review is based on ISO/IEC Directives Part 2: 2018, which in Table 5 states
198 "May" signifies permission expressed by the document, whereas "can" refers to the ability of a
199 user of the document or to a possibility open to him/her.

200 All internal clause references etc. in the document have been changed from pure text into active
201 Hyperlinks. This makes it possible to look up references by simply clicking the reference. This
202 feature can be carried over into pdf versions.

203 A review of definitions has been made in order to align, where applicable, to IEC 60050 as
204 published in electropedia.org

205 The requirement that “Note to entry” (in definitions) shall always be numbered even if only one,
206 has been implemented

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

HIGH-VOLTAGE TEST TECHNIQUES

Part 2: Measuring systems

FOREWORD

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- 217 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising
218 all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international
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248 rights. IEC shall not be held responsible for identifying any or all such patent rights.
- 249 IEC 60060-2 has been prepared by IEC technical committee 42: High-voltage test techniques.
250 It is an International Standard.
- 251 This fourth edition of IEC 60060-2 cancels and replaces the third edition, published in 2010,
252 and constitutes a technical revision.
- 253 The significant technical changes with respect to the previous edition are as follows:
- 254 a) The general layout and text were updated and improved to make the standard easier to use.
255 b) The standard was revised to align it with IEC 60060-1 Edition 4.
256 c) The treatment of measurement uncertainty estimation has been expanded.
257 d) This document is now applicable to measuring systems used in testing at all standard
258 insulation levels specified in IEC 60071-1.
259 e) The measurement uncertainty requirement for the front time of the standard lightning impulse
260 voltage has been changed from 10% to 15%, for testing at all standard insulation levels
261 specified in IEC 60071-1.

- 262 f) Parameter “time-to-peak” of the switching impulse defined in IEC 60060-1 Ed.3 has now
 263 been replaced by “front time” in IEC 60060-1 Ed.4. Necessary changes have been made in
 264 this document to accommodate this change in IEC 60060-1.
- 265 g) Annex B.1 has been significantly revised to align more closely with the provisions of Clause
 266 5, including using the same nomenclature.

267

268 The text of this International Standard is based on the following documents:

Draft	Report on voting
XX/XX/FDIS	XX/XX/RVD

269

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

272 The language used for the development of this International Standard is English.

273 This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in
 274 accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available
 275 at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are
 276 described in greater detail at www.iec.ch/standardsdev/publications.

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

- 280 • reconfirmed,
- 281 • withdrawn,
- 282 • replaced by a revised edition, or
- 283 • amended.

284

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HIGH-VOLTAGE TEST TECHNIQUES

Part 2: Measuring systems

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294 **1 Scope**

295 This part of IEC 60060 is applicable to complete measuring systems, and to their components,
296 used for the measurement of high voltages during laboratory and factory tests with direct
297 voltage, alternating voltage and lightning and switching impulse voltages as specified in
298 IEC 60060-1. For measurements during on-site tests see IEC 60060-3.

299 The limits on uncertainties of measurements stated in this standard apply to test levels stated
300 in IEC 60071-1. The principles of this standard apply also to higher levels but the uncertainty
301 can be greater.

302 This standard:

- 303 • defines the terms used;
- 304 • describes methods to estimate the uncertainties of high-voltage measurements;
- 305 • states the requirements which the measuring systems shall meet;
- 306 • describes the methods for approving a measuring system and checking its components;
- 307 • describes the procedures by which the user shall show that a measuring system meets the
308 requirements of this standard, including the limits set for the uncertainty of measurement.

309 **2 Normative references**

310 The following referenced documents are indispensable for the application of this standard. For
311 dated references, only the edition cited applies. For undated references, the latest edition of
312 the referenced document (including any amendments) applies.

313 IEC 60052, *Voltage measurement by means of standard air gaps*

314 IEC 60060-1, *High-voltage test techniques – Part 1: General definitions and test requirements*

315 IEC 60071-1, *Insulation co-ordination – Part 1: Definitions, principles and rules*

316 IEC 61083-1, *Instruments and software used for measurement in high-voltage impulse tests –*
317 *Part 1: Requirements for instruments*

318 IEC 61083-2, *Digital recorders for measurement in high-voltage impulse tests – Part 2:*
319 *Evaluation of software used for the determination of the parameters of impulse waveforms*

320 ISO/IEC Guide 98-3:2008, *Uncertainty of measurement – Part 3: Guide to the expression of*
321 *uncertainty in measurements (GUM: 1995)*

322 NOTE Further related standards, guides, etc. on subjects included in this Document are given in the bibliography.

323 **3 Terms and definitions**

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

3.1 Measuring systems

3.1.1

measuring system

complete set of devices suitable for performing a high-voltage measurement; software, used to obtain or calculate measuring results, also forms a part of the measuring system

NOTE 1 to entry A measuring system usually comprises the following components:

– a converting device with the leads required for connecting this device to the test object or into the circuit and the connections to earth;

– a transmission system connecting the output terminals of the converting device to the measuring instruments with its attenuating, terminating and adapting impedances or networks;

– a measuring instrument together with any connection to the power supply. Measuring systems which comprise only some of the above components or which are based on non-conventional principles are acceptable if they meet the uncertainty requirements specified in this document;

– and in some cases the measuring chain can include software to calculate the measurand.

NOTE 2 to entry The environment in which a measuring system functions, its clearances to live and earthed structures and the presence of electric or magnetic fields can significantly affect the measurement result and its uncertainty.

3.1.2

record of performance

detailed record, established and maintained by the user, describing the measuring system and containing evidence that the requirements given in this standard have been met

NOTE 1 to entry This evidence includes the results of the initial performance test and the schedule and results of each subsequent performance test and performance check.

3.1.3

approved measuring system

measuring system that is shown to comply with one or more of the sets of requirements set out in this document

3.1.4

reference measuring system

measuring system with its calibration traceable to relevant national and/or international standards, and having sufficient accuracy and stability for use in the approval of other systems by making simultaneous comparative measurements with specific types of waveform and ranges of voltage

NOTE 1 to entry A reference measuring system (maintained according to the requirements of this standard) may be used as an approved measuring system but the converse is not true.

3.2 Components of a measuring system

3.2.1

converting device

device for converting the quantity to be measured (measurand) into a quantity, compatible with the measuring instrument

3.2.2

voltage divider

device comprising resistors, inductors, capacitors, transformer(s) or a combination of these components such that, between two points of the device, a desired fraction of the voltage applied to the device as a whole can be obtained

[SOURCE: IEC 60050-312:2001, 312-02-32]

371 **3.2.3**
372 **voltage transformer**
373 an instrument transformer consisting of a transformer in which the secondary voltage, in normal
374 conditions of use, is substantially proportional to the primary voltage and differs in phase from
375 it by an angle which is approximately zero for an appropriate direction of the connections

376 [SOURCE: IEC 60050-321:1986, 321-03-01]

377 **3.2.4**
378 **voltage converting impedance**
379 converting device which carries a current proportional to the applied voltage to be measured
380 with a current measuring instrument

381 **3.2.5**
382 **electric-field probe**
383 converting device for the measurement of the amplitude and waveform of an electric field

384 NOTE 1 to entry An electric-field probe can be used to measure the waveform of the voltage producing the field
385 provided that the measurement is not affected by corona or space charges.

386 **3.2.6**
387 **transmission system**
388 set of devices that transfers the output signal of a converting device to a measuring instrument

389 NOTE 1 to entry A transmission system usually consists of a coaxial cable with its terminating impedance, but it
390 can include attenuators, amplifiers, or other devices connected between the converting device and the measuring
391 instrument. For example, an optical link includes a transmitter, an optical cable and a receiver as well as related
392 amplifiers.

393 NOTE 2 to entry A transmission system can be partially or completely included in the converting device or in the
394 measuring instrument.

395 **3.2.7**
396 **measuring instrument**
397 device intended to make measurements, alone or in conjunction with supplementary devices

398 [SOURCE IEC 60050-311:2001, 311-03-01]

399 **3.3 Scale factors**

400 **3.3.1**
401 **scale factor of a measuring system**
402 factor by which the value of the measuring-instrument reading is multiplied to obtain the value
403 of the input quantity of the complete measuring system

404 NOTE 1 to entry A measuring system can have multiple scale factors for different assigned measurement ranges,
405 frequency ranges or waveforms.

406 NOTE 2 to entry For measuring systems that display the value of the input quantity directly, the nominal scale factor
407 of the measuring system is unity.

408 **3.3.2**
409 **scale factor of a converting device**
410 factor by which the output of the converting device is multiplied to obtain its input quantity

411 NOTE 1 to entry The scale factor of a converting device can be dimensionless (for example, the ratio of a divider)
412 or can have dimensions (for example, the impedance of a voltage converting impedance).

413 **3.3.3**
414 **scale factor of a transmission system**
415 factor by which the output of a transmission system is multiplied to obtain its input quantity

416 **3.3.4**
417 **scale factor of a measuring instrument**
418 factor by which the instrument reading is multiplied to obtain its input quantity

419 **3.3.5**
420 **assigned scale factor**
421 F
422 scale factor of a measuring system determined at the most recent performance test

423 NOTE 1 to entry A measuring system can have more than one assigned scale factor; for example, it can have
424 several ranges and/or nominal epochs, each with a different scale factor.

425 **3.4 Rated values**

426 **3.4.1**
427 **operating conditions**
428 specified ranges of conditions under which a measuring system will operate within the specified
429 uncertainty limits

430 **3.4.2**
431 **rated operating voltage**
432 maximum level of voltage of specified frequency or waveform at which a measuring system is
433 designed to be used

434 NOTE 1 to entry The rated operating voltage can be higher than the upper limit of the assigned measurement range.

435 **3.4.3**
436 **assigned measurement range**
437 range of voltage of specified frequency or waveform, characterized by a single scale factor, in
438 which a measuring system can be used

439 NOTE 1 to entry The limits of the assigned measurement range are chosen by the user and verified by the
440 performance tests specified in this standard.

441 NOTE 2 to entry A measuring system can have more than one assigned measurement range with different scale
442 factors.

443 **3.4.4**
444 **assigned operating time**
445 longest time during which a measuring system for direct or alternating voltages can operate at
446 the upper limit of the assigned measurement range

447 **3.4.5**
448 **assigned rate of application**
449 highest rate of specified voltage impulses for a specified time interval, at which the measuring
450 system can operate at its upper limit of the assigned measurement range

451 NOTE 1 to entry The rate is usually given as applications per minute and the time interval in minutes or hours.

452 **3.5 Definitions related to dynamic behaviour**

453 **3.5.1**
454 **response of a measuring system,**
455 G
456 output, as a function of time or frequency, when a specified voltage is applied to the input of
457 the system

458 **3.5.2**
459 **amplitude-frequency response,**
460 $G(f)$
461 ratio of the output to the input of a measuring system as a function of frequency f , when the
462 input is sinusoidal (see Figure 1)