



SLOVENSKI STANDARD
oSIST prEN IEC 63405:2026
01-maj-2026

Visokonapetostne preskusne tehnike - Meritve dielektričnih izgub "predlagan horizontalni standard"

High-voltage test techniques - Dielectric loss measurements "PROPOSED HORIZONTAL STANDARD"

Techniques des essais à haute tension - Mesurages des pertes diélectriques "NORME HORIZONTALE PROPOSÉE"

Ta slovenski standard je istoveten z: prEN IEC 63405:2026

ICS:

19.080	Električno in elektronsko preskušanje	Electrical and electronic testing
--------	---------------------------------------	-----------------------------------

oSIST prEN IEC 63405:2026 **en**

Sample Document

get full document from standards.iteh.ai



42/473/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER: IEC 63405 ED1	
DATE OF CIRCULATION: 2026-03-13	CLOSING DATE FOR VOTING: 2026-06-05
SUPERSEDES DOCUMENTS: 42/461/CD, 42/470/CC	

IEC TC 42 : HIGH-VOLTAGE AND HIGH-CURRENT TEST TECHNIQUES	
SECRETARIAT: Canada	SECRETARY: Mr Howard G. Sedding
OF INTEREST TO THE FOLLOWING COMMITTEES: TC 2,TC 14,TC 17,SC 17A,SC 17C,SC 18A,TC 20,TC 23,TC 32,TC 36,TC 37,TC 112,TC 122	HORIZONTAL FUNCTION(S):
ASPECTS CONCERNED:	
<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

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Recipients of this document are invited to submit, with their comments, notification of any relevant "In Some Countries" clauses to be included should this proposal proceed. Recipients are reminded that the CDV stage is the final stage for submitting ISC clauses. (SEE [AC/22/2007](#) OR [NEW GUIDANCE DOC](#)).

TITLE:

High-voltage test techniques - Dielectric loss measurements "PROPOSED HORIZONTAL STANDARD"

PROPOSED STABILITY DATE: 2028

NOTE FROM TC/SC OFFICERS:

Copyright © 2026 International Electrotechnical Commission, IEC. All rights reserved. It is permitted to download this electronic file, to make a copy and to print out the content for the sole purpose of preparing National Committee positions. You may not copy or "mirror" the file or printed version of the document, or any part of it, for any other purpose without permission in writing from IEC.

CONTENTS

1		
2		
3	FOREWORD.....	4
4	INTRODUCTION.....	6
5	1 Scope.....	7
6	2 Normative references	7
7	3 Terms and definitions	7
8	3.1 Definitions for dielectric measuring systems.....	7
9	3.2 Definitions for dielectric properties	8
10	3.3 Definitions related to tests on dielectric measuring systems	10
11	4 Measuring system of capacitance and loss	11
12	4.1 Capacitance and loss factor measurement.....	11
13	4.2 Representation of capacitive equipment.....	11
14	4.3 Dielectric dissipation factor measuring system	12
15	4.3.1 General	12
16	4.3.2 High-voltage reference	12
17	4.3.3 Measuring instrument	14
18	5 Procedures for qualification and use of measurement systems	17
19	5.1 General principles.....	17
20	5.2 Schedule of performance tests.....	18
21	5.3 Schedule of performance checks	18
22	5.4 Requirements for the record of performance	18
23	5.4.1 Contents of the record of performance.....	18
24	5.4.2 Exceptions.....	18
25	5.5 Operating conditions	19
26	5.6 Uncertainty and traceability.....	19
27	6 Tests and test requirements for an approved measuring system and its	
28	components.....	19
29	6.1 General requirements	19
30	6.2 Tests and test requirements for high-voltage standard capacitors	20
31	6.2.1 General	20
32	6.2.2 Tests on the high-voltage standard capacitor.....	20
33	6.2.3 Performance tests on the high-voltage standard capacitor	22
34	6.2.4 Performance checks on the high-voltage standard capacitor.....	22
35	6.3 Tests and test requirements for measuring instruments.....	23
36	6.3.1 General	23
37	6.3.2 Tests of measuring instruments	23
38	6.3.3 Performance tests on measurement instruments.....	26
39	6.3.4 Performance checks on measuring instruments	26
40	7 Test procedure	26
41	7.1 General.....	26
42	7.2 Requirements for the test voltage	27
43	7.3 Connection of the test object.....	27
44	7.3.1 Ungrounded Specimen Test.....	27
45	7.3.2 Grounded Specimen Test	28
46	8 Test Report	29
47	Annex A (informative) Dielectric dissipation factor reference	30

IEC CDV 63405 © IEC 2026

48	Annex B (informative) Example for measurement uncertainty of capacitance and	
49	dielectric dissipation factor of a high-voltage standard capacitor.....	32
50	B.1 Purpose	32
51	B.2 Measurement model.....	32
52	B.3 Sensitivity coefficient	33
53	B.4 Description of each uncertainty component input	33
54	B.4.1 Uncertainty component input $u(x_{1in})$	33
55	B.4.2 Uncertainty component input $u(x_{2in})$	34
56	B.4.3 Uncertainty component input $u(x_{3in})$	34
57	B.4.4 Uncertainty component input $u(x_{4in})$	34
58	B.4.5 Uncertainty component input $u(x_{5in})$	34
59	B.4.6 Uncertainty component input $u(x_{6in})$	34
60	B.4.7 Uncertainty component input $u(d_{1in})$	34
61	B.4.8 Uncertainty component input $u(d_{2in})$	34
62	B.4.9 Uncertainty component input $u(d_{3in})$	35
63	B.4.10 Uncertainty component input $u(d_{4in})$	35
64	B.4.11 Uncertainty component input $u(d_{5in})$	35
65	B.4.12 Uncertainty component input $u(d_{6in})$	35
66	B.5 Summary of all uncertainty components	35
67	B.6 Expression of expanded uncertainty of measurement results	37
68	B.6.1 Capacitance Measurement Results	37
69	B.6.2 Dielectric Dissipation Factor Measurement Results	37
70	Annex C (Informative) Example for measuring dielectric dissipation factor with UST	38
71	C.1 General.....	38
72	C.2 Test Object	38
73	C.3 Preparation	38
74	C.4 Test Procedure	38
75	C.5 Test Results.....	39
76	Annex D (Informative) Example for measuring dielectric dissipation factor with GST	40
77	D.1 General.....	40
78	D.2 Test Object	40
79	D.3 Preparation	40
80	D.4 Test Procedure	40
81	D.5 Test Results.....	41
82	Bibliography.....	42
83		
84	Figure 1 – Vector diagram for a test object showing the voltage and current vectors.....	11
85	Figure 2 – Series equivalent representation and parallel representation of a	
86	capacitive equipment	12
87	Figure 3 – Coaxial electrode type high-voltage standard capacitor.....	13
88	Figure 4 – Typical circuit diagram for a Schering Bridge	15
89	Figure 5 – Typical circuit diagram for a transformer ratio-arm bridge with manual	
90	adjustment.....	16
91	Figure 6 – Typical circuit diagrams of digital sampling equipment	17
92	Figure 7 – Test circuit for calibration of the high-voltage bridge	24

IEC CDV 63405 © IEC 2026

93	Figure 8 – circuit diagram based on the low-voltage conductivity method for	
94	Dielectric dissipation factor calibration	24
95	Figure 9 – circuit diagram for calibration of the instruments with built-in high-voltage	
96	power supply	25
97	Figure 10 – An example circuit diagram for device of performance check	26
98	Figure 11 – Typical circuit diagram using impedance ratio-arm bridge for Ungrounded	
99	Specimen Test.....	28
100	Figure 12 – Typical circuit diagram using digital sampling instruments for	
101	Ungrounded Specimen Test.....	28
102	Figure 13 – Typical circuit diagram using digital sampling instrument for grounded	
103	Specimen Test.....	29
104	Figure A.1 – Structural diagram of dielectric dissipation factor reference	30
105	Figure C.1 Test circuit for measuring $\tan \delta$ of the main insulation of the wall bushing	
106	with UST method	38
107	Figure D.1 Test circuit for measuring $\tan \delta$ of the end screen of the wall bushing with	
108	GST method	40
109		
110	Table 1 – Tests for qualification of a high-voltage standard capacitor	20
111	Table 2 – Tests required for approved measurement instruments	23
112	Table B.1 –The results of 10 times measurements	33
113	Table B.2 – uncertainty components for capacitance	37
114	Table C.1 – Test Results of the main insulation of the wall bushing with UST	39
115	Table D.1 –Test Results of the end screen of the wall bushing with GST	41
116		
117		

118 CAPACITANCE AND DIELECTRIC LOSS MEASUREMENTS

119

120

121 **HIGH-VOLTAGE TEST TECHNIQUES – CAPACITANCE AND DIELECTRIC**
122 **LOSS MEASUREMENTS**

123

124

125

FOREWORD

126 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising
127 all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international
128 co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and
129 in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports,
130 Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their
131 preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with
132 may participate in this preparatory work. International, governmental and non-governmental organizations liaising
133 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.

134 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international
135 consensus of opinion on the relevant subjects since each technical committee has representation from all
136 interested IEC National Committees.

137 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National
138 Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC
139 Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any
140 misinterpretation by any end user.

141 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications
142 transparently to the maximum extent possible in their national and regional publications. Any divergence between
143 any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.

144 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity
145 assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any
146 services carried out by independent certification bodies.

147 6) All users should ensure that they have the latest edition of this publication.

148 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and
149 members of its technical committees and IEC National Committees for any personal injury, property damage or
150 other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and
151 expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC
152 Publications.

153 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is
154 indispensable for the correct application of this publication.

155 9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a)
156 patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in
157 respect thereof. As of the date of publication of this document, IEC had not received notice of patents, which may
158 be required to implement this document. However, implementers are cautioned that this may not represent the
159 latest information, which may be obtained from the patent database available at <https://patents.iec.ch> or
160 www.iso.org/patents. IEC shall not be held responsible for identifying any or all such patent rights.

161 IEC 63405 has been prepared by working group WG24: High-voltage test techniques - Dielectric
162 loss measurements, of IEC technical committee 42: High-voltage and high-current test
163 techniques. It is an International Standard.

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

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

165

166 Full information on the voting for its approval can be found in the report on voting indicated in
167 the above table.

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

169 This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in
170 accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, [and the
171 ISO/IEC Directives, JTC 1 Supplement] available at www.iec.ch/members_experts/refdocs. The

IEC CDV 63405 © IEC 2026

172 main document types developed by IEC are described in greater detail at
173 www.iec.ch/publications.

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

- 177 • reconfirmed,
- 178 • withdrawn,
- 179 • replaced by a revised edition, or
- 180 • amended.

181

Sample Document

get full document from standards.iteh.ai

182

INTRODUCTION

183 The electric power industry requires standardized tools to provide confidence in the
184 measurement of capacitance and dielectric loss, and to prove equivalence between tests
185 performed in different test facilities.

186 The measurement of capacitance and dielectric loss are effective methods to determine the
187 insulation status of electrical equipment. Capacitance and dielectric loss measurement are
188 widely used in electrical equipment manufacturers, power grid companies, colleges and
189 universities, testing and inspection institutions and other units. IEC 63405 specifies the general
190 principles and requirements for the measurement of capacitance and dielectric loss.

191 The procedures of Clause 5 have been modelled on IEC 60060-2:2025, Clause 4.

192

Sample Document

get full document from standards.iteh.ai

193 **HIGH-VOLTAGE TEST TECHNIQUES — CAPACITANCE AND DIELECTRIC**
 194 **LOSS MEASUREMENTS**

195
196
197
198

199 **1 Scope**

200 This document of IEC 63405 is applicable to the measurement of capacitance and dielectric
 201 loss at power frequency for electrical apparatus, components, or systems, with the highest
 202 voltage for equipment U_m above 1 kV.

203 This document

204 - defines the terms used

205 - suggests methods of test

206 - suggests test object connections

207 - provides possible test procedures

208 - provides guidance on requirements of calibration

209 This document is primarily concerned with capacitance and dielectric loss measurements for
 210 electrical equipment, such as capacitors, cables, power transformers, bushings, switches,
 211 circuit breakers, and instrument transformers. The tests of insulation materials (solid, liquid,
 212 gas, etc.) or power electronics components are NOT included in this standard.

213 **2 Normative references**

214 The following documents are referred to in the text in such a way that some or all of their content
 215 constitutes requirements of this document. For dated references, only the edition cited applies.
 216 For undated references, the latest edition of the referenced document (including any
 217 amendments) applies.

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

219 IEC 60060-2, *High-voltage test techniques – Part 2: Measuring systems*

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

222 **3 Terms and definitions**

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

224 ISO and IEC maintain terminology databases for use in standardization at the following
 225 addresses:

- 226 • IEC Electropedia: available at <https://www.electropedia.org/>
- 227 • ISO Online browsing platform: available at <https://www.iso.org/obp>

228 **3.1 Definitions for dielectric measuring systems**

229 **3.1.1**

230 **dielectric measuring system**

231 complete set of devices suitable for performing a dielectric measurement

232 Note 1 to entry: A dielectric measuring system usually comprises the following components:

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

IEC CDV 63405 © IEC 2026

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

237 – a measuring instrument together with any connection to the power supply;

238 – and in some cases, the measuring system can include software to calculate the measured value.

239 3.1.2

240 record of performance

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

243 Note 1 to entry: This evidence includes the results of the initial performance test and the schedule and results of
244 each subsequent performance test and performance check.

245 [SOURCE: IEC 60060-2:2025, term 3.1.2]

246 3.1.3

247 approved dielectric measuring system

248 dielectric measuring system that is shown to comply with one or more of the sets of
249 requirements in this document

250 3.1.4

251 reference dielectric measuring system

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

256 Note 1 to entry: A reference dielectric measuring system (maintained according to the requirements of this
257 standard) can be used as an approved dielectric measuring system but the converse is not true.

258 3.1.5

259 scale factor

260 <of a dielectric measuring system> factor by which the value of the measuring-instrument
261 reading is multiplied to obtain the value of the input quantity of the complete dielectric
262 measuring system

263 Note 1 to entry: A dielectric measuring system can have multiple scale factors for different assigned measurement
264 ranges, frequency ranges or waveforms.

265 Note 2 to entry: For dielectric measuring systems that display the value of the input quantity directly, the nominal
266 scale factor of the dielectric measuring system is unity.

267 [SOURCE: IEC 60060-2:2025, term 3.3.1]

268 3.2 Definitions for dielectric properties

269 3.2.1

270 electric constant

271 permittivity of vacuum

272 ε_0

273 scalar constant linking the electric quantities and the mechanical quantities, obtained from the
274 relation

$$\varepsilon_0 = \frac{1}{4\pi F} \cdot \frac{|Q_1 Q_2|}{r^2} \quad (1)$$

275 based on Coulomb's law in a vacuum, where F is the magnitude of the force between two
276 particles with electric charges Q_1 and Q_2 respectively, placed at a distance r apart.

277 Note 1 to entry: In a vacuum, the product of the electric constant ε_0 and the electric field vector E is equal to
278 the electric flux density vector D : $D = \varepsilon_0 E$.

279 Note 2 to entry: The electric constant ε_0 is related to the magnetic permeability of vacuum μ_0 and to the speed
280 of light in vacuum c_0 by the relation $\varepsilon_0 \mu_0 c_0^2 = 1$.

281 Note 3 to entry: The value of the electric constant ϵ_0 is equal to $8,8541878128(13) \cdot 10^{-12} \text{ A} \cdot \text{s} / (\text{V} \cdot \text{m})$.

282 [SOURCE: IEC 60050-121:2021, 121-11-03]

283 3.2.2

284 absolute permittivity

285 permittivity ϵ

286 scalar quantity or tensor quantity, the product of which by the electric field strength E in a
287 medium is equal to the electric flux density D :

$$D = \epsilon E \quad (2)$$

288 Note 1 to entry: For an isotropic medium, the absolute permittivity is a scalar quantity; for an anisotropic medium,
289 it is a tensor quantity.

290 [SOURCE: IEC 60050-121:2021, 121-12-12]

291 3.2.3

292 relative permittivity ϵ_r

293 scalar quantity or tensor quantity equal to the absolute permittivity divided by the electric
294 constant

295 Note 1 to entry: For an isotropic medium, the relative permittivity is a scalar quantity; for an anisotropic medium, it
296 is a tensor quantity.

297 Note 2 to entry: In the case of constant fields and alternating fields of sufficiently low frequency, the relative
298 permittivity of an isotropic or quasi-isotropic dielectric is equal to the ratio of the capacitance of a capacitor, in which
299 the space between and around the electrodes is entirely and exclusively filled with the dielectric medium, to the
300 capacitance of the same configuration of electrodes in vacuum. However, this use is not recommended.

301 Note 3 to entry: In practical engineering, it is usual to employ the term "permittivity" when referring to relative
302 permittivity, but this use is deprecated since "permittivity" is a synonym for "absolute permittivity".

303 [SOURCE: IEC 60050-121:2021, 121-12-13]

304 3.2.4

305 complex relative permittivity $\underline{\epsilon}_r$

306 under sinusoidal conditions in a medium where the phasors \underline{D} and \underline{E} representing respectively
307 the electric flux density vector and the electric field vector are linearly related, complex quantity
308 $\underline{\epsilon}_r$ defined by the relation

$$\underline{D} = \epsilon_0 \underline{\epsilon}_r \underline{E} \quad (3)$$

309 where

310 ϵ_0 is the electric constant

311 Note 1 to entry: The complex relative permittivity is generally frequency dependent. For an isotropic medium, the
312 complex relative permittivity is a scalar quantity; for an anisotropic medium, it is a tensor quantity.

313 Note 2 to entry: Generally, $\underline{\epsilon}_r$ is expressed as $\underline{\epsilon}_r = \epsilon_r' - j\epsilon_r''$ where ϵ_r' is the real relative permittivity and ϵ_r'' is the
314 dielectric loss index, which represents dielectric losses.

315 [SOURCE: IEC 60050-121:2021, 121-12-14]

316 3.2.5

317 dielectric loss

318 power absorbed from a time-varying electric field by a polarised substance, excluding absorbed
319 power due to conductivity of the substance

320 Note 1 to entry: The dielectric loss is usually dissipated as heat.

321 Note 2 to entry: In 60050-121 dielectric loss is defined as power absorbed from a time-varying electric field by a
322 polarized substance, excluding absorbed power due to the conductivity of the substance. In practice the loss due to
323 the conduction current in the dielectric is usually included in the dielectric loss.

324 [SOURCE: IEC 60050-212:2010, 212-11-27]