



DPC: 22/30363312 DC

BSI Group Headquarters

389 Chiswick High Road London W4 4AL

Tel: +44 (0)20 8996 9000

Fax: +44 (0)20 8996 7400

www.bsigroup.com

Date: 11 May 2022

Origin: International

Latest date for receipt of comments: 22 June 2022

Project No. 2017/02215

Responsible committee: PEL/36 Insulators for power systems

Interested committees:

Title: Draft BS EN 61109 Insulators for overhead lines. Composite suspension and tension insulators for a.c. systems with a nominal voltage greater than 1 000 V - Definitions, test methods and acceptance criteria

Please notify the secretary if you are aware of any keywords that might assist in classifying or identifying the standard or if the content of this standard

- i) has any issues related to 3rd party IPR, patent or copyright
- ii) affects other national standard(s)
- iii) requires additional national guidance or information

WARNING: THIS IS A DRAFT AND MUST NOT BE REGARDED OR USED AS A BRITISH STANDARD. THIS DRAFT IS NOT CURRENT BEYOND 22 June 2022

This draft is issued to allow comments from interested parties; all comments will be given consideration prior to publication. No acknowledgement will normally be sent. **See overleaf for information on the submission of comments.**

No copying is allowed, in any form, without prior written permission from BSI except as permitted under the Copyright, Designs and Patent Act 1988 or for circulation within a nominating organization for briefing purposes. Electronic circulation is limited to dissemination by e-mail within such an organization by committee members.

Further copies of this draft may be purchased from BSI Shop <http://shop.bsigroup.com> or from BSI Customer Services, Tel: +44(0) 20 8996 9001 or email cservices@bsigroup.com. British, International and foreign standards are also available from BSI Customer Services.

Information on the co-operating organizations represented on the committees referenced above may be obtained from <https://standardsdevelopment.bsigroup.com/>.

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.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

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.**
- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
------------------	------------------------

1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (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.	



36/546/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER: IEC 61109 ED3	
DATE OF CIRCULATION: 2022-04-29	CLOSING DATE FOR COMMENTS: 2022-07-22
SUPERSEDES DOCUMENTS: 36/416/RR	

IEC TC 36 : INSULATORS	
SECRETARIAT: Sweden	SECRETARY: Mr Dan Windmar
OF INTEREST TO THE FOLLOWING COMMITTEES: TC 11	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☐ ENVIRONMENT ☒ QUALITY ASSURANCE ☐ SAFETY	

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.

TITLE:
Insulators for overhead lines - Composite suspension and tension insulators for a.c. systems with a nominal voltage greater than 1 000 V - Definitions, test methods and acceptance criteria

NOTE FROM TC/SC OFFICERS:

Copyright © 2022 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	CONTENTS	2
3	FOREWORD	5
4	INTRODUCTION	7
5	1 Scope and object	8
6	2 Normative references	8
7	3 Terms, definitions and abbreviations	9
8	3.1 Terms and definitions	9
9	3.2 Abbreviations	12
10	4 Identification	12
11	5 Environmental conditions	12
12	6 Transport, storage and installation	14
13	7 Tolerances	14
14	8 Classification of tests	14
15	8.1 Design tests	14
16	8.2 Type tests	15
17	8.3 Sample tests	15
18	8.4 Routine tests	15
19	9 Design tests	18
20	9.1 General	18
21	9.2 Test specimens for IEC 62217	18
22	9.2.1 Tests on interfaces and connections of end fittings	18
23	9.2.2 Tracking and erosion test	19
24	9.2.3 Tests on core material	19
25	9.2.4 Tests on core with housing	19
26	9.3 Product specific pre-stressing for tests on interfaces and connections of end fittings as in IEC 62217	19
27	9.3.1 Sudden load release	19
28	9.3.2 Thermal-mechanical pre-stress	19
29	9.4 Assembled core load-time tests	20
30	9.4.1 Test specimens	20
31	9.4.2 Mechanical load test	21
32	10 Type tests	21
33	10.1 Electrical tests	21
34	10.2 Damage limit proof test and test of the tightness of the interface between end fittings and insulator housing	23
35	10.2.1 Test specimens	23
36	10.2.2 Performance of the test	23
37	10.2.3 Evaluation of the test	24
38	11 Sample tests	24
39	11.1 General rules	24
40	11.2 Verification of dimensions (E1 + E2)	25
41	11.3 Verification of the end fittings (E2)	25
42	11.4 Verification of tightness of the interface between end fittings and insulator housing (E2) and of the specified mechanical load, SML (E1)	25
43	11.5 Galvanizing test (E2)	26
44	11.6 Water diffusion tests on core with housing (E2)	26

48	11.7 Minimum sheath thickness. (E2)	26
49	11.8 Re-testing procedure	27
50	12 Routine tests	28
51	12.1 Mechanical routine test	28
52	12.2 Visual examination	28
53	Annex A (informative) Principles of the damage limit, load coordination and testing for	
54	composite suspension and tension insulators	29
55	A.1 Introductory remark	29
56	A.2 Load-time behaviour and the damage limit	29
57	A.3 Service load coordination	30
58	A.4 Verification tests	32
59	Annex B (informative) Example of two possible devices for sudden release of load	34
60	B.1 Device 1 (Figure B.1)	34
61	B.2 Device 2 (Figure B.2)	34
62	Annex C (informative) Guidance on non-standard mechanical stresses and dynamic	
63	mechanical loading of composite insulators	36
64	C.1 Introductory remark	36
65	C.2 Torsion loads	36
66	C.3 Compressive (buckling) loads	36
67	C.4 Bending loads	37
68	C.5 Dynamic mechanical loads	37
69	C.6 Limits	37
70	Annex D (informative) Electric field control for a.c.	39
71	Annex E (informative) Principles of the mechanical adhesion tests (pull-off and peel	
72	tests) intended for qualitative evaluation of adhesion core/housing	41
73	E.1 Introductory remark	41
74	E.2 Principle sketch of for long rod insulators assembly	41
75	E.3 Test objects	43
76	E.4 Test method	44
77	E.5 Criterion	46
78	Annex F (informative) Applicability of design- and type tests for d. c. applications	47
79		

80	Figure 1 – Thermal-mechanical test.....	20
81	Figure 2 – Position of specimen generation	26
82	Figure 3 – Method of re-testing at different stages	27
83	Figure A.1 – Load-time strength and damage limit of a core assembled with fittings .	30
84	Figure A.2 – Graphical representation of the relationship of the damage limit to the	
85	mechanical characteristics and service loads of an insulator with a 16 mm diameter	
86	core.....	31
87	Figure A.3 – Applied specific force relationship example 1	31
88	Figure A.4 – Applied specific force relationship example 2	32
89	Figure A.5 – Test loads	33
90	Figure B.1 – Example of possible device 1 for sudden release of load	34
91	Figure B.2 – Example of possible device 2 for sudden release of load	35
92	Figure E.1.- Interface description for insulator with housing made by modular assembly	
93	41	
94	Figure E.2.- Interface description for insulator with housing made by injection molding	
95	and overmolded end fitting	42
96	Figure E.3 – Comparison and correlation of breaking tensile stress between pull-off	
97	test and peel test.	42
98	Figure E.4 – Comparison of breaking tensile stress obtained in pull-off tests by tensile	
99	machine or manual cell.	43
100	Figure E.5 – Example of test object for pull-off test	43
101	Figure E.6 – Example of test object for peel test	44
102	Figure E.7 – Example of standard tensile machine	45
103	Figure E.8 – Example of manually operated load cell	45
104	Figure E.9 – Method of peel test and tested samples after peel test	46
105		
106	Table 1 – Normal environmental conditions	13
107	Table 2 – Tests to be carried out after design changes	16
108	Table 3 – Design tests	18
109	Table 4 – Application and Mounting arrangements for electrical tests	22
110	Table 5 – Sample sizes	25
111		

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INSULATORS FOR OVERHEAD LINES
COMPOSITE SUSPENSION AND TENSION INSULATORS
FOR ELECTRICAL SYSTEMS WITH A NOMINAL VOLTAGE
GREATER THAN 1 000 V –
DEFINITIONS, TEST METHODS AND ACCEPTANCE CRITERIA**

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 provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 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.

International Standard IEC 61109 has been prepared by subcommittee 36B: Insulators for overhead lines, of IEC technical committee 36: Insulators.

This **third** edition cancels and replaces the second edition, published in **2008**. This edition constitutes a technical revision.

The main technical changes with respect to the previous edition are listed below:

- **modifications of Terms, definitions and abbreviations;**
- **removal of chapter 7 "Hybrid insulators" from this standard;**
- **modifications of tests procedures recently included in IEC 62217 (Hydrophobicity transfer test; Stress corrosion, Water diffusion test on the core with housing);**
- **modifications on environmental conditions;**
- **modifications on classification of tests and include the relevance of the interfaces;**

- clarification and modification of the parameters determining the need to repeat design and type tests, Table 1 revised;
- Revision of electrical type tests;
- Revision of re-testing procedure of sample test;
- addition of a new Annex D on electric field control for a.c.
- addition of a new Annex F on the principles of the mechanical adhesion tests (pull-off and peel tests)
- addition of a new Annex G Applicability of design- and type tests for Direct Current (d. c.)

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

FDIS	Report on voting

Full information on the voting for the approval of this standard 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.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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.

193

INTRODUCTION

194 Composite suspension and tension insulators (in the following the term “composite insulator” is
195 used) consist of fibreglass insulating core, bearing the mechanical load protected by a
196 polymeric housing, the load being transmitted to the core by metallic end fittings. Despite these
197 common features, the materials used and the design and manufacturing details used by
198 different manufacturers may differ.

199 Some tests have been grouped together as “Design tests”, to be performed only once on
200 insulators which satisfy the same design conditions. For all design tests of these composite
201 insulators, the appropriate common clauses defined in IEC 62217 are applied. As far as
202 practical, the influence of time on the electrical and mechanical properties of the components
203 (core material, housing, interfaces etc.) and of the complete composite insulators has been
204 considered in specifying the design tests to ensure a satisfactory lifetime under normally known
205 stress conditions of transmission lines. Explanation of the principles of the damage limit, load
206 coordination and testing are presented in Annex A.

207 It has not been considered useful to specify a power arc test as a mandatory test. The test
208 parameters are manifold and can have very different values depending on the configurations of
209 the network and the supports and on the design of arc-protection devices. The heating effect of
210 power arcs should be considered in the design of metal fittings. Critical damage to the metal
211 fittings resulting from the magnitude and duration of the short-circuit current can be avoided by
212 properly designed arc-protection devices. This standard, however, does not exclude the
213 possibility of a power arc test by agreement between the user and manufacturer. IEC 61467 [1]¹
214 gives details of a.c. power arc testing of complete insulator sets, that shall duplicate their actual
215 configuration with actual protective and string fittings, to recreate the real electromagnetic field
216 affecting the arc movement.

217 This standard covers both a. c. and d. c. composite insulators. Before the appropriate standard
218 for d. c. applications will be issued, the majority of tests listed in this standard can also be
219 applicable for d. c. (Appendix G). Due to the difference in a.c. and d. c. tracking performance,
220 a specific tracking and erosion test procedure for d. c. applications as a design test shall be
221 developed. The 1000 h a. c. tracking and erosion test of IEC 62217 can be used only to establish
222 a minimum requirement for the tracking and erosion resistance. This 1000 h salt fog tracking
223 and erosion test is considered as a screening test intended to reject materials or designs which
224 are inadequate. Tracking and erosion tests are not intended to evaluate long term performance
225 of insulators. Such tests, e.g. the 5000 h multiple stress test and wheel test in IEC/TR 62730
226 or other tests, intended for research or sometimes used as a supplementary design test, are
227 not considered in the present standard.

228 Composite insulators are usually not intended for torsion or other non-tensile loads. However
229 due consideration to non-standard applications (interphase spacers etc.) and installation loads
230 should be considered in the design. Guidance on non-standard loads is given in Annex C.

231 Wherever possible, IEC Guide 111 [5] has been followed for the drafting of this standard.

232

¹ Figures in square brackets refer to the bibliography.

**INSULATORS FOR OVERHEAD LINES –
COMPOSITE SUSPENSION AND TENSION INSULATORS
FOR **ELECTRICIAL** SYSTEMS WITH A NOMINAL VOLTAGE
GREATER THAN 1 000 V –
DEFINITIONS, TEST METHODS AND ACCEPTANCE CRITERIA**

1 Scope and object

This International Standard applies to composite insulators **for overhead lines** consisting of a load-bearing cylindrical insulating solid core consisting of fibres – usually glass – in a resin-based matrix, a housing (surrounding the insulating core) made of polymeric material and **metal** end fittings permanently attached to the insulating core.

Composite insulators covered by this standard are intended for use as suspension/tension line insulators, but it should be noted that these insulators can occasionally be subjected to compression or bending, for example when used as interphase-spacers.

The object of this standard is to

- define the terms used,
- prescribe test methods,
- prescribe acceptance criteria.

This standard does not include requirements dealing with the choice of insulators for specific operating conditions or environments.

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 60383-1, *Insulators for overhead lines with a nominal voltage above 1 000 V – Part 1: Ceramic or glass insulator units for a.c. systems – Definitions, test methods and acceptance criteria*

IEC 60383-2, *Insulators for overhead lines with a nominal voltage above 1 000 V – Part 2: Insulator strings and insulator sets for a.c. systems – Definitions, test methods and acceptance criteria*.

IEC 61466-1, *Composite string insulator units for overhead lines with a nominal voltage greater than 1 000 V – Part 1: Standard strength classes and end fittings*

IEC 62217, *Polymeric insulators for indoor and outdoor use with a nominal voltage > 1 000 V – General definitions, test methods and acceptance criteria*

ISO 3452 (all parts), *Non-destructive testing – Penetrant testing*

3 Terms, definitions and abbreviations

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

NOTE 1 to entry: Certain terms from IEC 62217 are reproduced here for ease of reference. Additional definitions applicable to insulators can be found in IEC 60050-471 [6].

3.1 Terms and definitions

3.1.1

polymeric insulator

insulator whose insulating body consists of at least one organic based material

Note 1 to entry: Polymeric insulators are also known as non-ceramic insulators.

Note 2 to entry: Coupling devices may be attached to the ends of the insulating body.

[SOURCE: IEC 60050-471:2007, 471-01-13]

3.1.2

composite insulator

insulator made of at least two insulating parts, namely a core and a housing equipped with end fittings

Note 1 to entry: Composite insulators, for example, can consist either of individual sheds mounted on the core, with or without an intermediate sheath, or alternatively, of a housing directly moulded or cast in one or several pieces on to the core.

[SOURCE: IEC 60050-471:2007, 471-01-02]

3.1.3

core of a composite insulator

central insulating part of an insulator which provides the mechanical characteristics

Note 1 to entry: The housing and sheds are not part of the core.

[SOURCE: IEC 60050-471:2007, 471-01-11]

3.1.4

insulator trunk

central insulating part of an insulator from which the sheds project

Note 1 to entry: Also known as shank on smaller insulators.

[SOURCE: IEC 60050-471:2007, 471-01-11]

3.1.5

housing

external insulating part of composite insulator providing the necessary creepage distance and protects the core from the environment

Note 1 to entry: An intermediate sheath made of insulating material may be part of the housing.

[SOURCE: IEC 60050-471:2007, 471-01-09]

306 **3.1.6**
307 **shed of an insulator**
308 insulating part, projecting from the insulator trunk, intended to increase the creepage distance

309 Note 1 to entry: The shed can be with or without ribs.

310 [SOURCE: IEC 60050-471:2007, 471-01-15]

311 **3.1.7**
312 **interface**
313 contact surface between the different materials (see also Annex E)

314 Note 1 to entry: Various interfaces exist in composite insulators, e.g.:

315 - between housing and end fittings;

316 - between various parts of the housing; e.g. between separately manufactured sheds, or between sheath and sheds;

317 - between core and housing.

318 -between sealing and core

319 -between sealing and end fittings

320 [IEC 62217, section 3]

321 **3.1.8**
322 **end fitting**
323 integral component or formed part of an insulator intended to connect it to a supporting
324 structure, or to a conductor, or to an item of equipment, or to another insulator

325 Note 1 to entry: Where the end fitting is metallic, in general the term "metal fitting" is used.

326 [SOURCE: IEC 60050-471:2007, 471-01-06]

327 **3.1.9**
328 **connection zone**
329 zone where the mechanical load is transmitted between the insulating body and the end fitting

330 [Definition 3.17 of IEC 62217, modified]

331 **3.1.10**
332 **coupling**
333 part of the end fitting which transmits the load to the accessories external to the insulator

334 [Definition 3.17 of IEC 62217, modified]

335 **3.1.11**
336 **creepage distance**

337 shortest distance or the sum of the shortest distances along the surface on an insulator between
338 two conductive parts which normally have the operating voltage between them

339 [SOURCE: IEC 60050-471:2007, 471-01-04]

340

341 **3.1.12**
342 **arcing distance**

343 shortest distance in the air external to the insulator between the metallic parts which normally
344 have the operating voltage between them

345

346 Note 1 to entry – The term "dry arcing distance" is also used.

347 [IEV 471-01-01]

348

349

350 **3.1.11**

351 **specified mechanical load**

352 **SML**

353 load, specified by the manufacturer, which is used for mechanical tests in this standard

354 **3.1.12**

355 **routine test load**

356 **RTL**

357 load applied to all assembled composite insulators during a routine mechanical test

358 **3.1.13**

359 **mechanical failing load**

360 maximum load that is reached when the insulator is tested under the prescribed conditions

361 [IEV 471-01-12]

362

363 **3.1.14**

364 **insulator set**

365 assembly of one or more insulator strings suitably connected together, complete with end
366 fittings and protective devices as required in service.

367 [IEV 471-03-02]

368

369 **3.1.15**

370 **string insulator unit**

371 cap and pin insulator or long rod insulator of which the end fittings are suitable for flexible
372 attachment to other similar string insulator units or to connecting accessories.

373 [IEV 471-03-08]

374

3.2 Abbreviations

The following abbreviations are used in this standard:

E1, E2	Sample sets for sample tests
M_{AV}	Average 1 min failing load of the core assembled with fittings
RTL	Routine test load
SML	Specified mechanical load

4 Identification

In addition to the requirements of IEC 62217, each insulator shall be marked with the SML.

It is recommended that each insulator be marked or labelled by the manufacturer to show that it has passed the routine mechanical test.

5 Environmental conditions

Table 1 is copied from IEC 62217. It describes normal environmental conditions and may be slightly different for different products (polymeric, ceramic). If service conditions of overhead line composite insulators are beyond the parameters in this table, the insulator shall be specially designed/evaluated covering this new range. Practical comments are as follows:

Maximum ambient air temperature: *If exceeded, then follow the recommendations of IEC 62039 for the core and adhesive materials (like glue) in "Glass transition temperature" section.*

Minimum ambient air temperature: *As an example, silicone rubber has a typical crystallisation temperature of -44 °C. This is a fully reversible process, when the temperature rises above this threshold. If below this temperature, the handling rules for transportation and installation shall be verified to be applicable. Another example is the metal end fitting thus it applies to all insulator technologies. For installation during winter time with temperatures below -20 °C, special steel grades with low ductile transition temperature can be found in specifications.*

Solar radiation: *There is in general positive experience with composite insulators in high solar-radiated areas (deserts and high altitudes). If there is positive experience in the areas beyond 1000 W/m², the insulators can be used. If there is no service experience, it shall be verified that the materials can be applicable.*

Pollution: *Relevant standard IEC 60815-1 & 4 provides rules for the application of insulators in the "Very heavy" site pollution severity (SPS) class. Implementation of new SPS class "Extreme" is under consideration of IEC.*

The normal environmental conditions to which insulators are submitted in service are defined according to Table 1. Terms are defined as follows:

- Indoor insulation: insulators installed within a building or other housing, where the insulators are protected against wind, rain, snow, periodical fast-built pollution deposits, abnormal condensation, ice and hoar frost.*
- Outdoor insulation: Insulators installed in open air outside any building or shelter, where the insulators are capable to withstand wind, rain, snow, periodical fast-built pollution deposits, high condensation, ice and hoar frost.*

If service conditions of polymeric insulators deviate significantly from the parameters in Table 1, the insulator is to design/evaluate specially according to tests agreed between customer and manufacturer. Alternatively, if positive service experience is available for a specific environment and specific insulator design (including material and profile), the insulator can be used for this specific environment, deviating from normal conditions.

Table 1 – Normal environmental conditions

	Indoor insulation	Outdoor insulation
Maximum ambient air temperature ^a	Does not exceed 40 °C and its average value measured over a period of 24 h does not exceed 35 °C	
Minimum ambient air temperature ^b	-25 °C	-40 °C
Maximum ambient air temperature ^a	Does not exceed 40 °C and its average value measured over a period of 24 h does not exceed 35 °C	
Minimum ambient air temperature ^b	-25 °C	-40 °C
Vibration	Negligible vibration due to causes external to the insulators or to earth tremors c.	
Solar UV radiation ^d	Not applicable	Up to a level of 1 000 W/m ²
Site pollution severity ^e	No significant pollution by dust, smoke, corrosive and/or flammable gases, vapors, or salt.	Pollution by dust, smoke, corrosive gases, vapors or salt occurs. Pollution does not exceed SPS class "heavy" as defined in IEC 60815-1.
Humidity ^f	No rain, snow, abnormal humidity, condensation, ice and hoar frost	Rain, snow, abnormal humidity, condensation, ice and hoar frost occur.

^a If exceeded, follow the recommendations of IEC 62039 for the core and adhesive materials (like glue) in "glass transition temperature" section.

^b In general, temperatures below -40 °C are non-critical for service. However, for handling and installation the crystallization temperature of the polymeric housing is to consider. For line installations during winter time with temperatures below -20 °C, special steel grades with low ductile transition temperature can be specified.

^c Vibration due to external causes can be dealt with in accordance to IEC 60721-1.

^d For outdoor application, the influence of deviation from the assumed level of 1000 W/m² depends on the insulator material. No additional verifications are required for specific polymeric solutions with proven good experience in areas with high solar-radiation (deserts and high altitudes). In the absence of significant service experience, special tests simulating the solar radiation condition of the installation area have to be carried out.

^e In general, pollution is not an issue for indoor insulators. In particular cases, such as d. c. indoor conditions, the insulators can accumulate some contamination due to d. c. electrical field. However, the pollution flashover phenomena cannot develop when the humidity is controlled. For outdoor conditions the requirements of IEC 62217 are specified for stresses arising in relatively harsh but not extreme environments (see e. g. for hydrophobicity verification and tracking and erosion tests for which criteria are provided in IEC 62039). No additional tests are required for specific polymeric designs with proven good experience in areas with very heavy and extreme pollution. In the absence of reliable service experience, additional tests simulating the pollution and service conditions in the installation areas have to be carried out.

^f Insulators for indoor applications can also be used in presence of limited deviations from the above conditions if sufficient proven field experience is available and condensation occurs only occasionally. To limit condensation-related phenomena, the average value of the relative humidity, measured over a period of 24 h, has not to exceed 95 % and measured over a period of one month, not exceed 95 %.

6 Transport, storage and installation

In addition to the requirements of IEC 62217, information on handling of composite insulators can be found in CIGRE Technical Brochure 184 [7]. During installation, or when used in non-standard configurations, composite insulators may be submitted to high torsion, compression or bending loads for which they are not designed. Annex C gives guidance for such loads.

7 Tolerances

Unless otherwise agreed, a tolerance of

$$\pm (0,04 \times d + 1,5) \text{ mm when } d \leq 300 \text{ mm,}$$

$$\pm (0,025 \times d + 6) \text{ mm when } d > 300 \text{ mm with a maximum tolerance of } \pm 50 \text{ mm,}$$

shall be allowed on all dimensions for which specific tolerances are not requested or given on the insulator drawing (d being the dimension in millimetres).

The measurement of creepage distances shall be related to the design dimensions and tolerances as determined from the insulator drawing, even if this dimension is greater than the value originally specified. When a minimum creepage is specified, the negative tolerance is also limited by this value.

In the case of insulators with creepage distance exceeding 3 m, it is allowed to measure a short section around 1 m long of the insulator and to extrapolate.

8 Classification of tests

8.1 Design tests

These tests are intended to verify the suitability of the design, materials and method of manufacture (technology). A composite insulator design is defined by the following elements:

- Housing materials (EPDM, HTV Silicone, RTV Silicone, ...) and their manufacturing (injection moulding, modular process, one-piece compression moulding) / assembly (shed and sheath are assembled separately) methods
- Core materials (Polyester resin, Epoxy resin, ...) and their manufacturing process (pultrusion, filament winding)
- End fittings materials (Steel, Ductile Iron, Malleable Iron) and their manufacturing process method (forging, casting,...) and method of attachment (excluding the coupling);
- thickness of the housing surrounding the core (including a sheath where used);
- diameter of the core.
- Interfaces
 - core/housing interface design including type of coupling agent (primer) and assembly
 - Housing/end fitting interface design
 - Core end fitting interface
 - Trunk/Shed interface and Trunk/Trunk interface (if applicable)

When changes in the design occur, re-qualification shall be carried out in accordance with Table 1.