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TECHNICAL SPECIFICATION

Characteristics of hollow pressurised and unpressurised ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1000 V

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CHARACTERISTICS OF HOLLOW PRESSURISED AND UNPRESSURISED CERAMIC AND GLASS INSULATORS FOR USE IN ELECTRICAL EQUIPMENT WITH RATED VOLTAGES GREATER THAN 1000 V

FOREWORD

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- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC 62371, which is a technical specification, has been prepared by subcommittee 36C: Insulators for substations, of IEC technical committee 36: Insulators.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
36C/172/DTS	36C/173/RVC

Full information on the voting for the approval of this technical specification 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

- transformed into an International standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

The IEC standards concerning insulators for overhead lines and substations are classified into two categories. One is the standard for test methods and acceptance criteria and the other is the product standard in which characteristics of the insulators are specified. Product standards of most insulators, for example cap and pin type, long rod type insulators for overhead lines and station post insulators for substations, are available.

In the case of hollow insulators, test methods and acceptance criteria are standardized in IEC 62155: *Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1 000 V*, but there has been no product standard. This seems due to the difference in application among hollow insulators and other insulators. The hollow insulators are usually applied as a component of electrical equipment and other insulators such as cap and pin type or station post insulators are directly applied to the power system as equipment.

There are benefits for standardization of the hollow insulators, even if they are used as components, for insulator manufacturers, equipment manufacturers and final users for the equipment. That is, benefits of cost saving in respect of manufacturing and inventory control, short delivery, interchangeability, etc.

Taking account of every aspect on standardization of the hollow insulators, such as the fact that there are so many designs of electrical equipment, this Technical Specification covers only basic hollow insulators for normal application as a first step towards standardization work. Accordingly, special types of hollow insulators such as barrel type for some circuit-breakers, insulators for pollution and/or seismic areas, etc. are not within the scope of this specification.

Therefore, different hollow insulators not included in this specification can also be applied to the electrical equipment in the case where special characteristics are required, depending on environmental and/or system conditions. There may be the possibility to standardize those hollow insulators as a next step after gathering sufficient information on experiences.

In addition, it should be noted that the characteristics specified here are determined, considering the data collected through the survey on the presently available hollow insulators. There may be the possibility that the survey is not complete and then the hollow insulators not covered by this technical specification can also be applied. Such insulators as widely applied but not covered by this technical specification will be added in the next revision through ascertained experiences.

CHARACTERISTICS OF HOLLOW PRESSURISED AND UNPRESSURISED CERAMIC AND GLASS INSULATORS FOR USE IN ELECTRICAL EQUIPMENT WITH RATED VOLTAGES GREATER THAN 1000 V

1 Scope

This Technical Specification applies to

– ceramic and glass hollow insulators intended for general use in electrical equipment;
– ceramic hollow insulators intended for use with a permanent gas pressure in switchgear and controlgear.

They are intended for indoor and outdoor use in electrical equipment, operating on alternating current with a rated voltage greater than 1 000 V and a frequency not greater than 100 Hz or for use in direct current equipment with a rated voltage greater than 1 500 V.

This specification specifies the dimensional and mechanical characteristics of the hollow insulator, which are essential for interchangeability of the hollow insulator of the same type. It is not the object of this specification to prescribe electrical characteristics because they are dependent on the apparatus of which the hollow insulator ultimately forms a part. However, standard lightning impulse withstand voltage which is provided in IEC 60071-1 is described only for reference for classification purpose.

This specification applies to hollow insulators for use in electrical equipment in clean areas or lightly polluted areas, where seismic qualification is not required. For use in areas characterised by heavy pollution levels and for other particular or extreme environmental conditions such as seismic force, it may be necessary for certain dimensions to be changed.

The hollow insulators covered by this specification are:

a) straight type hollow insulators with metal fittings on both ends;
b) taper type hollow insulators with metal fittings on both ends;
c) straight type hollow insulators without metal fittings;
d) taper type hollow insulators without metal fittings.

The hollow insulators are intended for use in electrical equipment, for example:

– circuit-breakers;
– instrument transformers;
– surge arresters;
– bushings;
– cable sealing ends;
– switch-disconnectors;
– disconnectors;
– earthing switches;
– capacitors.

There may be some cases that hollow insulators whose design can strongly be influenced by other components of specific equipment, for example, active parts of circuit-breakers. For such cases, the hollow insulators can be separately designed, depending on respective requirements of such equipment and not be covered by this specification.

NOTE 1 Hollow insulators not prescribed in this specification can also be applied to electrical equipment, depending on specific requirements of the equipment. However, if similar insulators are available in this specification, it is preferable to apply them.

NOTE 2 For general recommendations for design and tests of the hollow insulators, see IEC 62155.

NOTE 3 For characteristics of hollow insulators for use in polluted areas, reference can be made to IEC 60815-1and IEC 60815-2.

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 62155, *Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1000 V*

3 Terms and definitions

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

3.1
arcing distance
shortest distance in air external to the insulator between the metallic parts which normally have the operating voltage between them

[IEV 471-01-01]

3.2
creepage distance
shortest distance along the external surface on an insulator between two conductive parts which normally have the operating voltage between them

[IEV 471-01-04, modified]

NOTE 1 The surface of cement or of other non-insulating jointing material is not considered as forming part of the creepage distance.

NOTE 2 If a high resistance coating is applied to parts of the insulating part of an insulator, such parts are considered to be effective insulating surfaces and the distance over them is included in the creepage distance.

NOTE 3 In case of hollow insulators without metal fitting, creepage distance is the shortest distance along the external surface on an insulator between the presumed position of two conductive parts as shown in Figures 3 and 4, unless otherwise agreed between the purchaser and the manufacturer.

3.3
end fitting
integral component or formed part of an insulator, intended to connect it to a supporting structure, or to a conductor, or to an item of equipment, or to another insulator

[IEV 471-01-06]

NOTE Where the end fitting is metallic, the term “metal fitting” is normally used.

3.4
hollow insulator
insulator which is open from end to end, with or without sheds, including end fittings

[IEV 471-01-08]

NOTE 1 A hollow insulator can be made from one or more permanently assembled insulating elements.

NOTE 2 Hollow insulators without end fittings are embraced.

3.5
manufacturer
organisation that produces the hollow insulators or hollow insulator bodies

3.6
straight type hollow insulator
hollow insulator which has the same inner and outer diameters from the top to the bottom

3.7
taper type hollow insulator
hollow insulator which has increasing inner and outer diameters from the top to the bottom

3.8
withstand bending moment
bending moment verified in a type test, which is based on load conditions specified for the hollow insulator

3.9
withstand inner pressure load
inner pressure load verified in a type test, which is based on load conditions specified for the hollow insulator

4 Dimensional and mechanical characteristics

Hollow insulators are characterized by the following:

– height of hollow insulator;
– arcing distance;
– creepage distance;
– diameter of insulating part;
– inner diameter of hollow insulator;
– withstand bending moment (when required);
– withstand inner pressure load (when required);
– pitch circle diameter of end fittings (only for flange type);
– diameter of clamping part (only for clamping type);
– number of bolt holes (only for flange type).

Where applicable, fixing holes shall be equally spaced on the appropriate pitch circle, which shall be concentric with the axis of the insulator. Holes in top and bottom fittings shall be in line, unless otherwise specified, and they shall be so arranged as to permit the use of normal hexagon bolt heads and nuts.

The corresponding values are specified in Tables 1 to 4. Each table corresponds to each hollow insulator type as follows:

– Table 1: straight type hollow insulators with metal fittings on both ends;
– Table 2: taper type hollow insulators with metal fittings on both ends;
– Table 3: straight type hollow insulators without metal fittings;
– Table 4: taper type hollow insulators without metal fittings.

Figures 1 to 4 illustrate typical examples of each type of the insulator.

The nominal dimensions of a hollow insulator shall be not greater than the specified maximum nor less than the specified minimum values. The actual dimensions of insulators are subject to the appropriate manufacturing tolerances. The tolerances of the hollow insulator shall be in accordance with 7.1 of IEC 62155 unless otherwise agreed between the purchaser and the manufacturer.

5 Marking

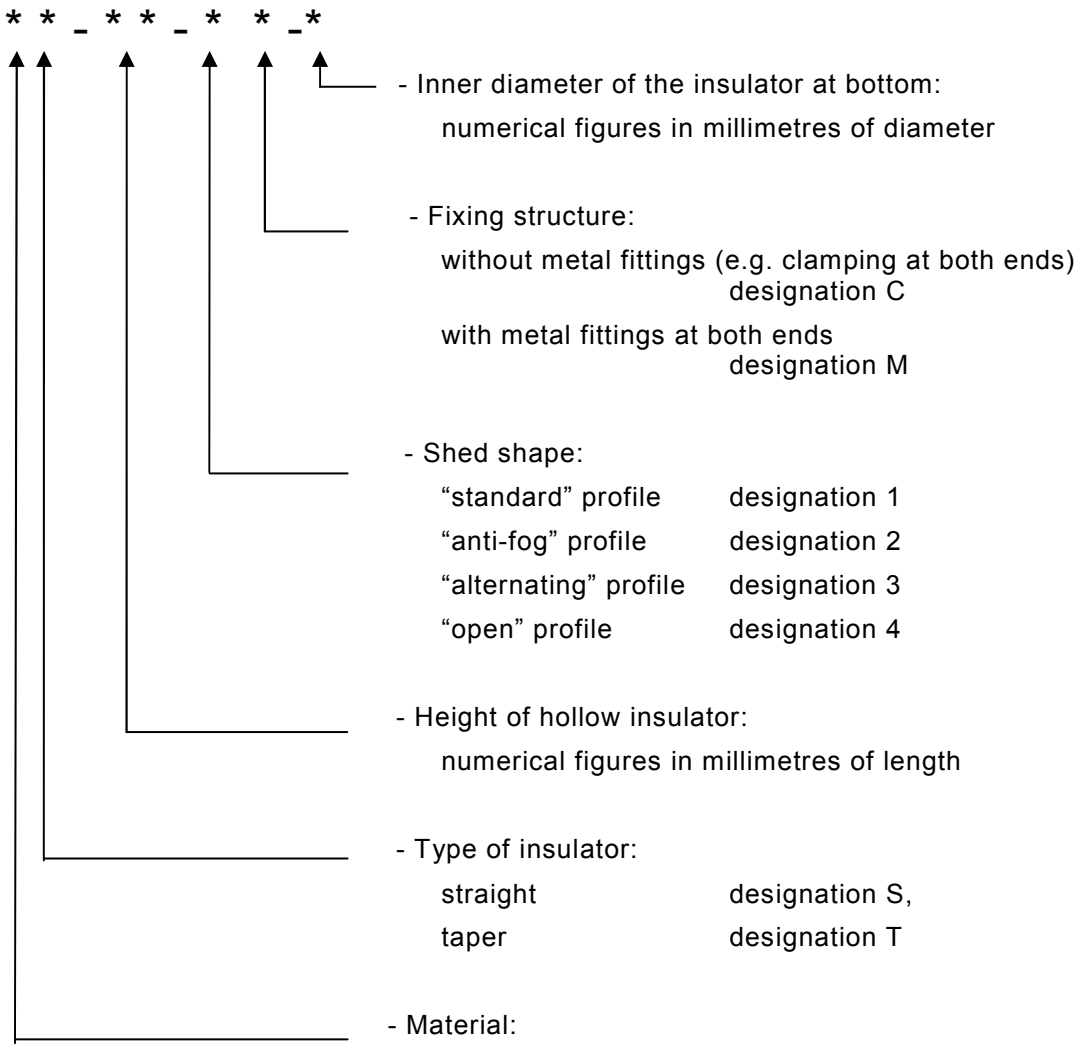
Each hollow insulator shall be marked in accordance with 11.1 of IEC 62155.

6 Fixing arrangement

The fixing arrangements of hollow insulators shall be in accordance with Tables 1 to 4.

7 Designation of hollow insulators

The hollow insulator is assigned by a reference symbol which indicates:



NOTE For type of shed shape, IEC 60815-1 can be referred to.

For example, designation PT-3350-1M-390 stands for ceramic taper type hollow insulator with a height of 3 350 mm, standard profile sheds, with metal fittings at both ends and inner diameter of 390 mm at the bottom.

Table 1 – Straight type hollow insulators with metal fittings on both ends

1	2	3	4	5	6	7	8	9	10	11	12
Hollow insulator designation [a]	**Lightning impulse withstand voltage** [b] kV	**Height of hollow insulator** mm	**Minimum arcing distance** mm	**Minimum nominal creepage distance** mm	**Maximum nominal diameter of insulating part** mm	**Inner diameter** mm	**Withstand bending moment** [c] kN-m	**Metal fitting pitch circle diameter**		**Number of bolt holes of metal fitting** [d]	
								Top mm	**Bottom** mm	**Top**	**Bottom**
PS- 420-1M-150	60	420	90	200	260	150	12,5	270	270	8	8
PS- 480-1M-150	75	480	120	280	260	150	12,3	270	270	8	8
PS- 480-1M-150	95	480	160	320	260	150	12,3	270	270	8	8
PS- 480-1M-150	125	480	220	380	260	150	12,3	270	270	8	8
PS- 480-1M-150	145	480	270	480	260	150	12,3	270	270	8	8
PS- 490-1M-150	170	490	320	530	260	150	12,2	270	270	8	8
PS- 650-1M-150	250	650	480	690	260	150	11,8	270	270	8	8
PS- 800-1M-150	325	800	630	940	260	150	11,6	270	270	8	8
PS-1070-1M-150	450	1 070	900	1 860	260	150	11,4	270	270	8	8
PS-1270-1M-150	550	1 270	1 100	2 210	260	150	11,3	270	270	8	8
PS-1470-1M-150	650	1 470	1 300	3 120	260	150	11,2	270	270	8	8
PS-1670-1M-150	750	1 670	1 500	3 120	260	150	11,1	270	270	8	8
PS-2470-1M-250	850	2 470	2 300	3 970	370	250	34,6	400	400	8	8

a Designation numbers indicate ceramic hollow insulators with standard profile shed. For glass hollow insulators, “P” should be changed to “G”. Shed type other than standard profile may be applied in accordance with agreement between the purchaser and the manufacturer. If such is the case, designation number “1M” should be changed accordingly to “2M” or the like.

b The lightning impulse withstand voltage is shown here only for reference for classification purposes. The values shown here are not the requirements for the hollow insulators in this specification.

c The withstand bending moment shown here is a typical example and can be changed by agreement between the manufacturer and the purchaser.

d By agreement between the manufacturer and the purchaser, fixing arrangements different from those given in columns 11 and 12 may be used.

Table 2 – Taper type hollow insulators with metal fittings on both ends

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Hollow insulator designation [a]	Lightning impulse withstand voltage [b] kV	Height of hollow insulator mm	Minimum arcing distance mm	Minimum nominal creepage distance mm	Maximum nominal diameter of insulating part mm	Inner diameter		Withstand bending moment [c] kN-m	Withstand inner pressure load [d] MPa	Metal fitting pitch circle diameter		Number of bolt holes of metal fitting [e]	
						Top mm	Bottom mm			Top mm	Bottom mm	Top	Bottom
PT- 330-1M-110	60	330	90	200	215	100	110	6,8	3	210	220	8	8
PT- 390-1M-110	75	390	120	280	215	100	110	6,6	3	210	220	8	8
PT- 390-1M-110	95	390	160	320	215	100	110	6,5	3	210	220	8	8
PT- 400-1M-120	125	400	220	380	225	100	120	7,6	3	210	235	8	8
PT- 400-1M-120	145	400	270	480	225	100	120	7,6	3	210	235	8	8
PT- 440-1M-130	170	440	320	530	235	100	130	8,7	3	210	245	8	8
PT- 620-1M-150	250	620	480	690	260	100	150	12,3	3	220	275	8	8
PT- 780-1M-170	325	780	630	940	280	100	170	15,2	3	220	295	8	8
PT-1060-1M-200	450	1 060	900	1 860	315	100	200	22,5	3	220	340	8	8
PT-1270-1M-230	550	1 270	1 100	2 210	345	100	230	28,8	3	220	375	8	8
PT-1490-1M-260	650	1 490	1 300	3 120	380	100	260	39,8	3	220	415	8	8
PT-1690-1M-280	750	1 690	1 500	3 120	400	100	280	45,3	3	220	435	8	8
PT-2520-1M-320	850	2 520	2 300	3 860	445	125	320	62,4	2,3	250	490	8	8
PT-2930-1M-340	950	2 930	2 700	4 710	465	125	340	69,6	2,3	250	515	8	12
PT-3340-1M-360	1 050	3 340	3 100	4 770	490	125	360	83,8	2,3	250	540	8	12
PT-3350-1M-390	1 175	3 350	3 100	7 000	520	125	390	97,8	2,3	250	575	8	12
PT-3870-1M-420	1 300	3 870	3 600	7 110	555	125	420	121,0	2,3	250	620	8	12
PT-4680-1M-450	1 425	4 680	4 400	7 220	590	125	450	147,2	2,3	250	660	8	12
PT-4690-1M-480	1 550	4 690	4 400	7 320	620	125	480	166,7	2,3	250	695	8	18
PT-5520-1M-510	1 675	5 520	5 200	11 000	655	150	510	199,0	2,3	285	735	8	18
PT-6440-1M-550	1 800	6 440	6 100	11 220	700	150	550	243,6	2,3	285	785	8	18
PT-7450-1M-580	1 950	7 450	7 100	11 350	730	150	580	268,6	2,3	285	820	8	18
PT-7470-1M-630	2 100	7 470	7 100	11 620	785	150	630	334,6	2	285	885	8	20

[a] Designation numbers indicate ceramic hollow insulators with standard profile shed. For glass hollow insulators, “P” should be changed to “G”. Shed type other than standard profile may be applied in accordance with agreement between the purchaser and the manufacturer. If such is the case, designation number “1M” should be changed accordingly to “2M” or the like.

[b] The lightning impulse withstand voltage is shown here only for reference for classification purposes. The values shown here are not the requirements for the hollow insulators in this specification.

[c] The withstand bending moment shown here is a typical example and can be changed by agreement between the manufacturer and the purchaser.

[d] The withstand inner pressure load is applied only to permanent inner pressure type insulator.

[e] By agreement between the manufacturer and the purchaser, fixing arrangements different from those given in columns 13 and 14 may be used.

Table 3 – Straight type hollow insulators without metal fittings

1	2	3	4	5	6	7	8	9
Hollow insulator designation [a]	**Lightning impulse withstand voltage** [b] kV	**Height of hollow insulator** mm	**Minimum arcing distance** mm	**Minimum nominal creepage distance** mm	**Maximum nominal diameter of insulating part** mm	**Inner diameter**[c] mm	**Diameter of clamping part**	
							Top mm	**Bottom** mm
PS- 420-1C-230	60	420	90	200	340	230	335	335
PS- 480-1C-230	75	480	120	280	340	230	335	335
PS- 480-1C-230	95	480	160	320	340	230	335	335
PS- 480-1C-230	125	480	220	380	340	230	335	335
PS- 480-1C-230	145	480	270	480	340	230	335	335
PS- 480-1C-230	170	480	320	530	340	230	335	335
PS- 550-1C-216	250	550	[d]	[d]	386	216	[d]	[d]
PS- 600-1C-230	250	600	480	690	340	230	335	335
PS- 750-1C-230	325	750	630	940	340	230	335	335
PS- 825-1C-216	450	825	[d]	[d]	386	216	[d]	[d]
PS-1020-1C-230	450	1 020	900	1 860	340	230	335	335
PS-1120-1C-216	550	1 120	[d]	[d]	386	216	[d]	[d]
PS-1220-1C-230	550	1 220	1 100	2 210	340	230	335	335
PS-1300-1C-216	650	1 300	[d]	[d]	386	216	[d]	[d]
PS-1470-1C-230	650	1 470	1 300	3 120	340	230	335	335
PS-1620-1C-230	750	1 620	1 500	3 120	340	230	335	335
PS-1800-1C-216	950	1 800	[d]	[d]	386	216	[d]	[d]
PS-2310-1C-295	1 175	2 310	[d]	[d]	485	295	[d]	[d]
PS-2420-1C-230	850	2 420	2 300	3 860	340	230	335	335
PS-3305-1C-295	1 425	3 305	[d]	[d]	485	295	[d]	[d]
PS-3305-1C-375	1 550	3 305	[d]	[d]	565	375	[d]	[d]
PS-3800-1C-375	1 675	3 800	[d]	[d]	565	375	[d]	[d]
PS-4300-1C-375	1 800	4 300	[d]	[d]	565	375	[d]	[d]

a Designation numbers indicate ceramic hollow insulators with standard profile shed. For glass hollow insulators, “P” should be changed to “G”. Shed type other than standard profile may be applied in accordance with agreement between the purchaser and the manufacturer. If such is a case, designation number “1C” should accordingly be changed to “2C” or the like.

b The lightning impulse withstand voltage is shown here only for reference for classification purposes. The values shown here are not the requirements for the hollow insulators in this specification.

c The inner diameter shown here is different from that in Table 1. This is considered partly due to difference in equipment, for which each hollow insulator is applied.

d There are no sufficient data at present. They can be provided according to the experiences in the future.

Table 4 – Taper type hollow insulators without metal fittings

1	2	3	4	5	6	7	8	9
Hollow insulator designation [a]	**Lightning impulse withstand voltage** [b] kV	**Height of hollow insulator** mm	**Minimum arcing distance** mm	**Minimum nominal creepage distance** mm	**Maximum nominal diameter of insulating part** mm	**Inner diameter**[c]		**Diameter of bottom clamping part** mm
						Top mm	**Bottom** mm	
PT- 170-1C- 45	60	170	90	200	135	40	45	100
PT- 230-1C- 50	75	230	120	280	140	40	50	105
PT- 235-1C- 50	95	235	160	320	140	40	50	105
PT- 245-1C- 55	125	245	220	380	145	40	55	110
PT- 295-1C- 60	145	295	270	480	150	55	60	115
PT- 345-1C- 65	170	345	320	530	160	55	65	125
PT- 505-1C- 80	250	505	480	690	175	55	80	140
PT- 655-1C- 90	325	655	630	940	185	55	90	150
PT-925-1C-110	450	925	900	1 860	210	80	110	175
PT-1140-1C-125	550	1 140	1 100	2 210	225	80	125	190
PT-1350-1C-145	650	1 350	1 300	3 120	250	80	145	215
PT-1560-1C-160	750	1 560	1 500	3 120	265	100	160	230
PT-2060-1C-200	850	2 060	2 000	3 820	310	100	200	275
PT-2360-1C-225	950	2 360	2 300	4 620	340	100	225	305
PT-2760-1C-255	1 050	2 760	2 700	4 620	375	140	255	340
PT-2760-1C-255	1 175	2 760	2 700	6 690	375	140	255	340
PT-3170-1C-290	1 300	3 170	3 100	6 680	410	140	290	380
PT-3770-1C-335	1 425	3 770	3 700	6 850	460	140	335	430
PT-3770-1C-335	1 550	3 770	3 700	6 850	460	140	335	430
PT-4470-1C-395	1 675	4 470	4 400	10 480	530	165	395	500
PT-5170-1C-450	1 800	5 170	5 100	11 010	595	200	450	565
PT-5285-1C-475	2 100	5 285	[d]	[d]	675	375	475	[d]
PT-5785-1C-475	2 550	5 785	[d]	[d]	675	375	475	[d]

1	2	3	4	5	6	7	8	9
Hollow insulator designation [a]	**Lightning impulse withstand voltage** [b] kV	**Height of hollow insulator** mm	**Minimum arcing distance** mm	**Minimum nominal creepage distance** mm	**Maximum nominal diameter of insulating part** mm	**Inner diameter**[c]		**Diameter of bottom clamping part** mm
						Top mm	**Bottom** mm	
PT-6070-1C-520	1 950	6 070	6 000	11 360	670	200	520	640
PT-6070-1C-520	2 100	6 070	6 000	11 360	670	200	520	640
PT-6275-1C-475	2 550	6 275	[d]	[d]	675	375	475	[d]

a Designation numbers indicate ceramic hollow insulators with standard profile shed. For glass hollow insulators, “P” should be changed to “G”. Shed type other than standard profile may be applied in accordance with agreement between the purchaser and the manufacturer. If such is the case, designation number “1C” should accordingly be changed to “2C” or the like.

b The lightning impulse withstand voltage is shown here only for reference for classification purposes. The values shown here are not the requirements for the hollow insulators in this specification.

c The inner diameter shown here is different from that in Table 2. This is considered partly due to difference in equipment, for which each hollow insulator is applied.

d There are no sufficient data at present. They can be provided according to the experiences in the future.

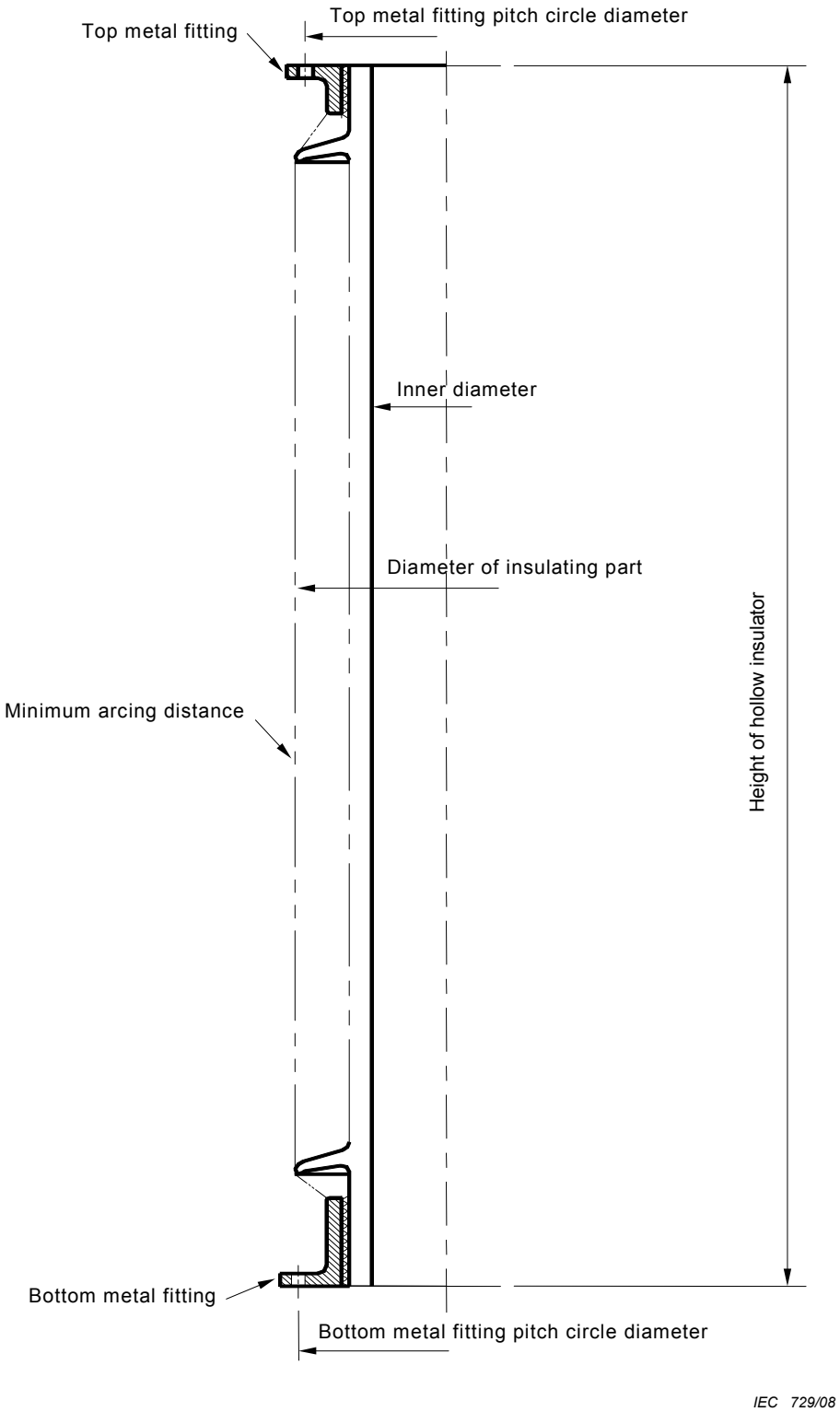


Figure 1 – Example of a straight type hollow insulator with metal fittings on both ends

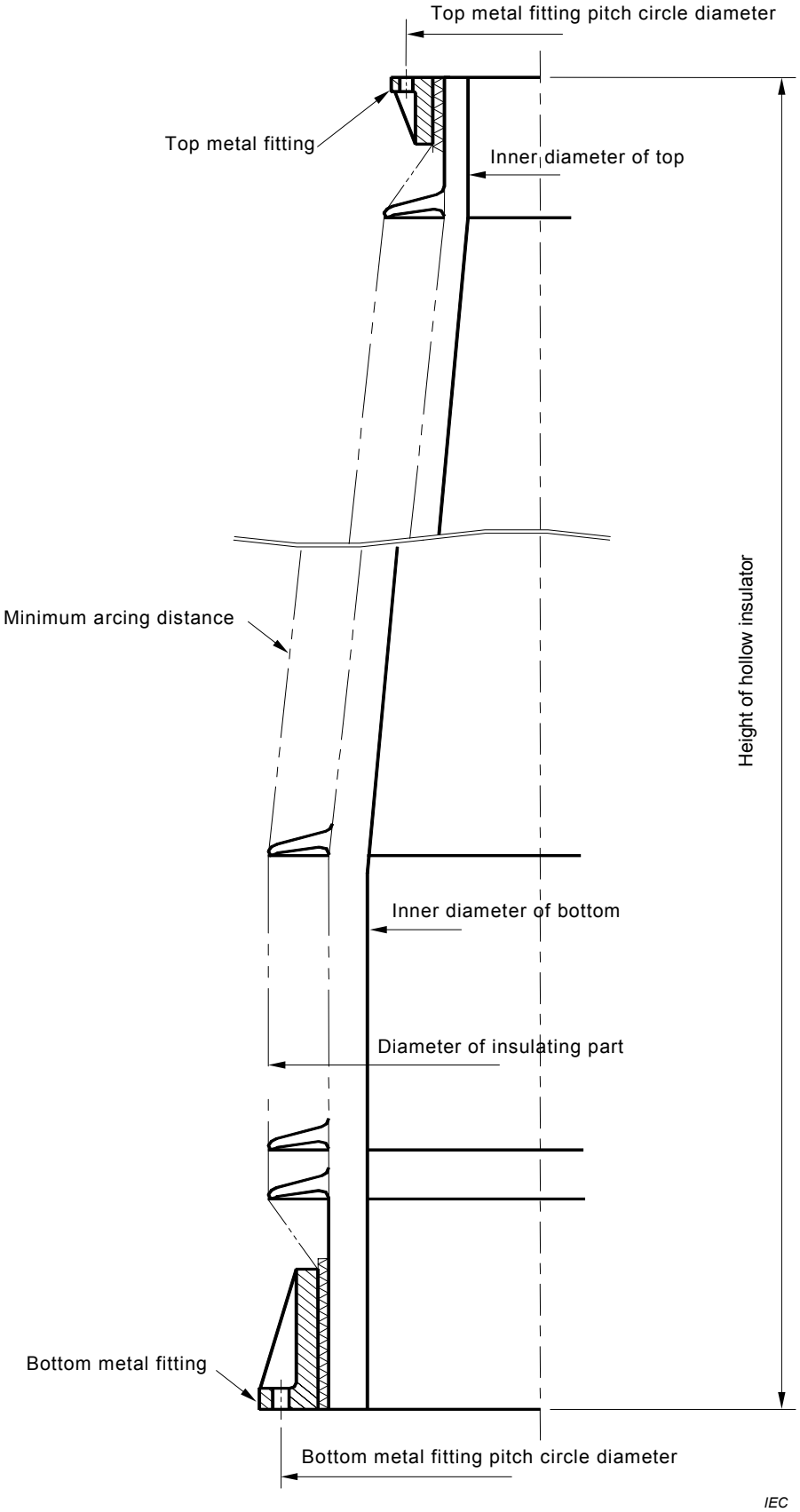


Figure 2 – Example of a taper type hollow insulator with metal fittings on both ends

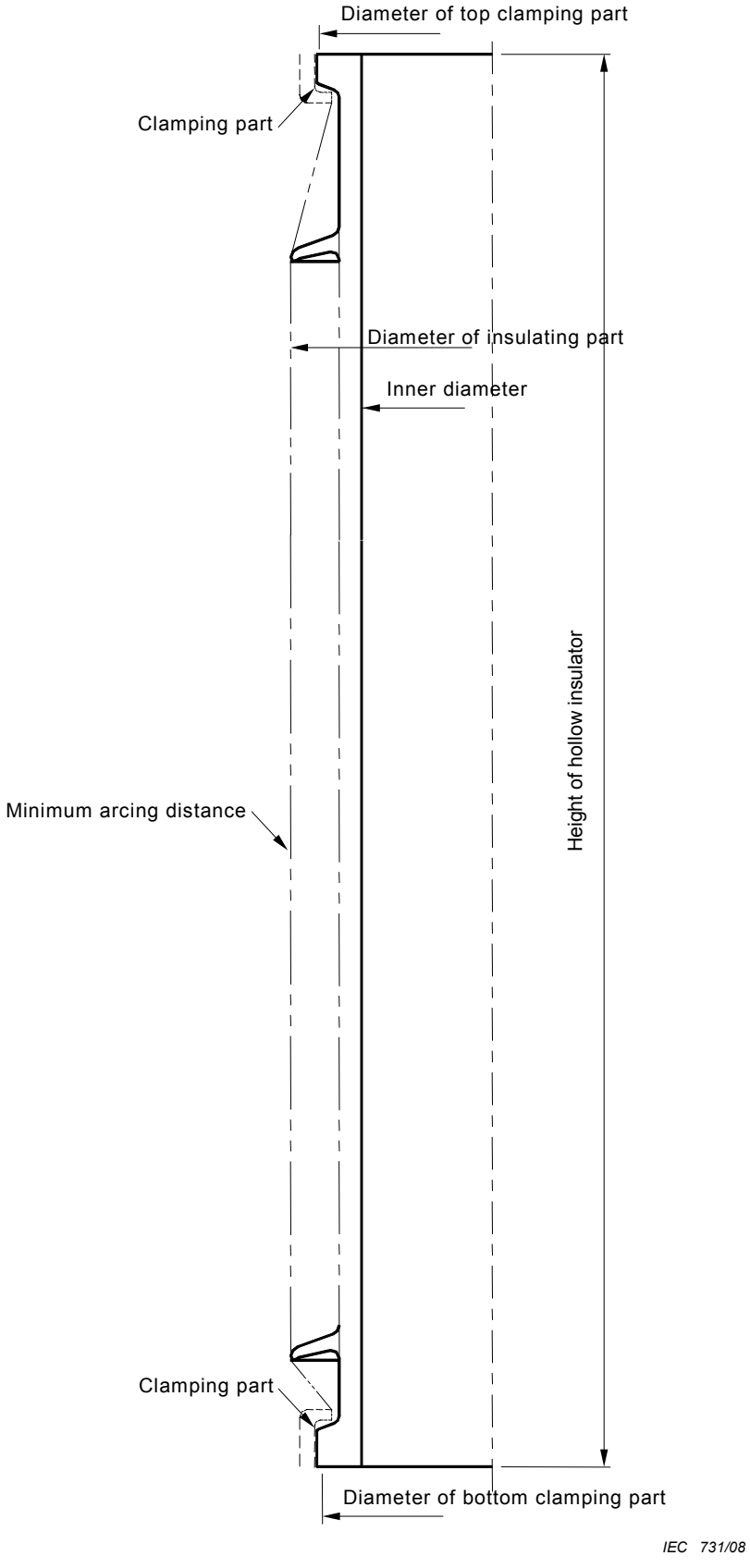


Figure 3 – Example of a straight type hollow insulator without metal fittings

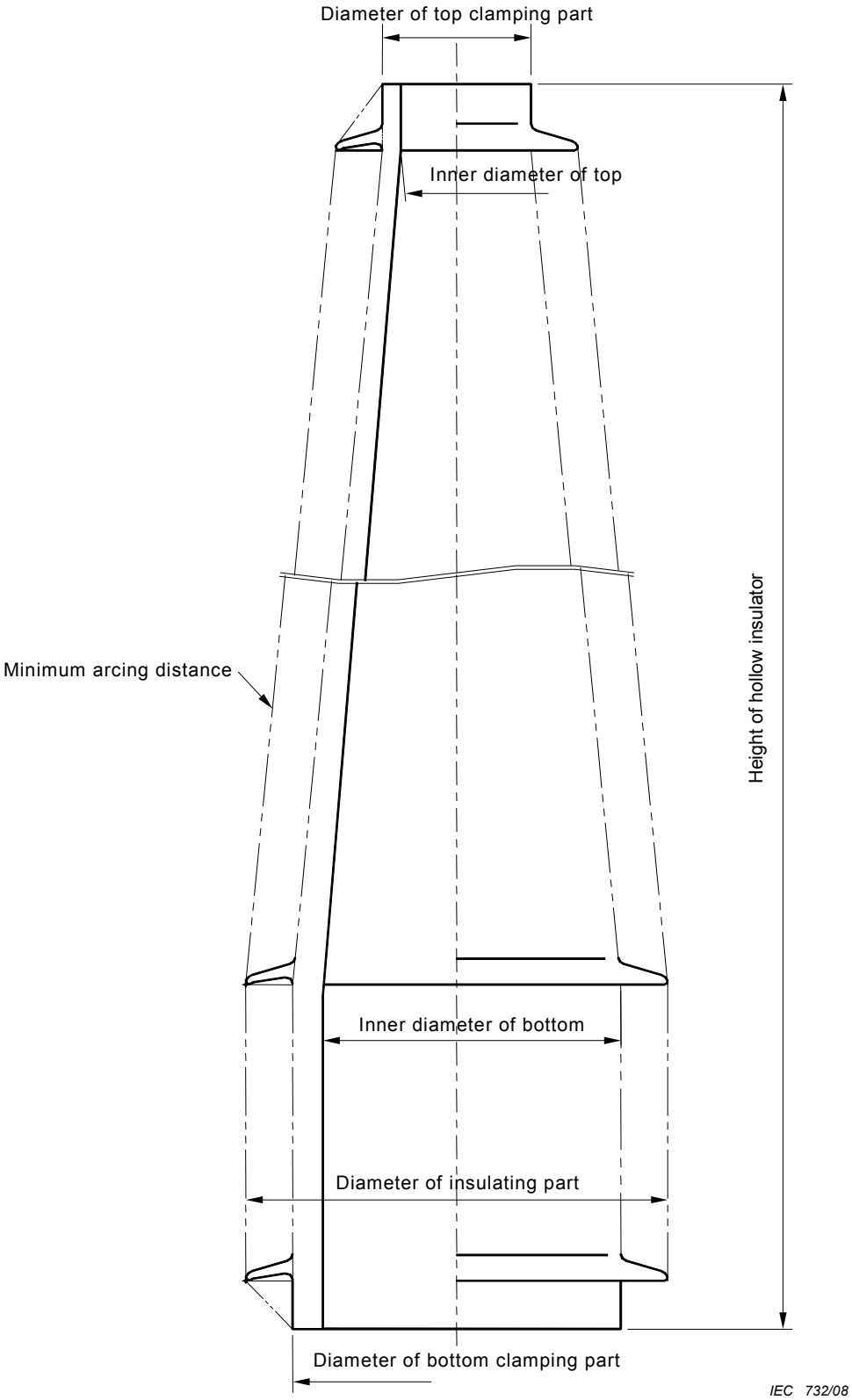


Figure 4 – Example of a taper type hollow insulator without metal fittings

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2 To be published.

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