BS EN 50180-1:2015

BSI Standards Publication

Bushings above 1 kV up to 52 kV and from 250 A to 3,15 kA for liquid filled transformers

Part 1: General requirements for bushings

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National foreword

This British Standard is the UK implementation of EN 50180-1:2015. Together with BS EN 50180-2:2015 and BS EN 50180-3:2015, it supersedes BS EN 50180:2010 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PEL/36, Insulators for power systems.

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This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Bushings above 1 kV up to 52 kV and from 250 A to 3,15 kA for liquid filled transformers - Part 1: General requirements for bushings

Traversées de tensions supérieures à 1 kV jusqu'à 52 kV et de 250 A à 3,15 kA pour transformateurs immergés dans un liquide - Partie 1: Exigences générales relatives aux traversées

Durchführungen über 1 kV bis 52 kV und von 250 A bis 3,15 kA für flüssigkeitsgefüllte Transformatoren - Teil 1: Allgemeine Anforderungen für Durchführungen

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European foreword

This document (EN 50180-1:2015) has been prepared by CLC/ TC 36A "Insulated bushings".

The following dates are fixed:

• latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2016-08-10
• latest date by which the national standards conflicting with this document have to be withdrawn	(dow)	2018-08-10

This document supersedes EN 50180:2010.

The only editorial modifications that have been done in EN 50180-1:2015 compared to EN 50180:2010 are the following:

1) EN 50180:2010 has been turned into EN 50180-1:2015 to allow the addition of two new parts;

2) an editorial correction of view "Y" on page 34 related to Figures A.16 and A.17 has been made.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

EN 50180 "*Bushings above 1 kV up to 52 kV and from 250 A to 3,15 kA for liquid filled transformers*" consists of the following parts:

– *Part 1: General requirements for bushings*;

– *Part 2: Requirement for bushing components*;

– *Part 3: Requirements for bushing fixations*.

Introduction

The object of this European Standard is to specify the requirements to ensure interchangeability of bushings having highest voltages above 1 kV up to 52 kV and rated currents from 250 A up to 3 150 A for insulating liquid filled transformers.

1 Scope

This European Standard is applicable to ceramic and resin insulated bushings having highest voltages above 1 kV up to 52 kV, rated currents from 250 A up to 3 150 A and frequencies from 15 Hz up to 60 Hz for insulating liquid filled transformers.

This European Standard establishes essential dimensions, to ensure interchangeability of bushings and to ensure adequate mounting and interchangeability of mating plug-in separable connectors of equivalent ratings.

2 Normative references

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

EN 60137, *Insulated bushings for alternating voltages above 1 000 V (IEC 60137)*

EN 60672-3, *Ceramic and glass-insulating materials — Part 3: Specifications for individual materials (IEC 60672-3)*

EN 62155, *Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1 000 V (IEC 62155)*

IEC/TS 60815 (all parts), *Selection and dimensioning of high-voltage insulators intended for use in polluted conditions*

NOTE It is highly advised to minimize the impact of bushings on the environment during all phases of their life (including manufacturing, operation during service life, dismantling after their end of life and disposal or recycling).

IEC Guide 109 and EN 62542 can be used as helpful reference.

3 Terms and definitions

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

3.1
open type bushing
bushing, one end of which is immersed in an insulating liquid with the other end in ambient air and exposed or not exposed to external atmospheric conditions

3.2
plug-in type bushing
bushing, one end of which is immersed in an insulating medium and the other end designed to receive a separable insulated cable connector without which the bushing cannot function

3.3
separable connector
fully insulated termination permitting the connection and disconnection of the cable to and from the mating plug-in type bushing

3.4
interface type
bushing dimensions that insure mechanical and electrical interchangeability of bushing and separable connector of similar rating and type. Each interface type is designated by a letter or a number

3.5
bail holder
fixture which facilitates anchoring of an externally mounted device (called the bail) designed to prevent undesirable separation of a separable connector and a bushing. A bail holder may or may not be an integral part of a bushing and is an optional feature

4 Requirements

4.1 Application

Open type bushings covered by this standard shall be suitable for operation with one end fully immersed in an insulating liquid and with the other in air.

Plug-in type bushings covered by this standard shall be suitable for operation with one end partially or fully immersed in an insulating medium and with the other in a separable connector.

4.2 Standard values of maximum voltage (U_m)

The value of U_m of a bushing shall be chosen from the standard values of the highest voltage for equipment U_m as given below, in kilovolts:

12 - 24 - 36 - 52

4.3 Standard values of rated current (I_r)

The value of I_r of a bushing shall be chosen from the standard values given below, in amperes:

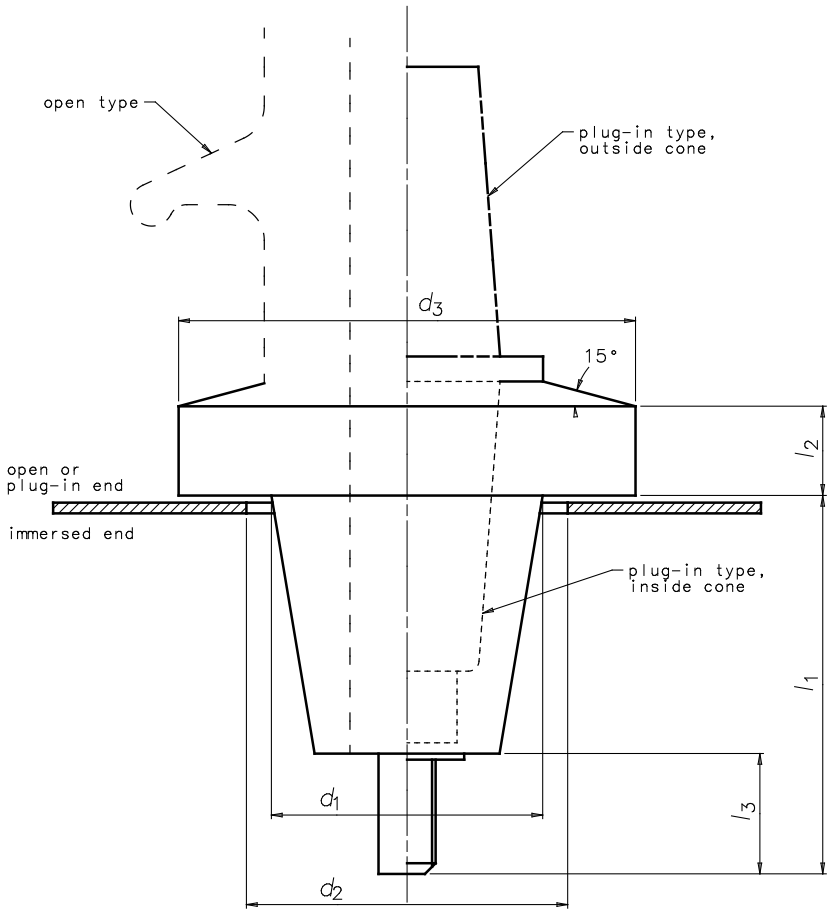
250 - 400 - 630 - 800 -1250 - 2000 - 3150

4.4 Compliance

Bushings shall meet the requirements of EN 60137.

4.5 Common dimensions

The dimensions necessary for interchangeability between open and plug-in type bushings shall be as specified in Figure 1 and Table 1.



NOTE For open type bushings the internal connection may be a flexible conductor or a stem.

Figure 1 —Common dimensions for open and plug-in type bushings

Table 1 — Common dimensions for open and plug-in type bushings

I_r A	U_m kV	d_1 mm	d_2 $^{+2}_{0}$ mm	d_3 mm	l_1 max. mm	l_2 mm	l_3 max. mm
250	12 ÷ 36	$^{0}_{-5}$ 77	^{0} 80	$^{0}_{-7}$ 111	145	$^{0}_{-2}$ 25	45
400 ÷ 630	12 ÷ 36	$^{0}_{-6}$ 87	90	$^{0}_{-8}$ 128	195	$^{0}_{-2}$ 25	75
800 ÷ 1 250	12 ÷ 36	$^{0}_{-7}$ 107	110	$^{0}_{-10}$ 165	215	$^{0}_{-2}$ 30	100
2 000 ÷ 3 150	12 ÷ 36	$^{0}_{-8}$ 132	135	$^{0}_{-11}$ 185	215	$^{0}_{-2}$ 30	100
250 ÷ 3 150	52	$^{0}_{-8}$ 132	135	$^{0}_{-11}$ 185	320	$^{+2}_{-2}$ 35	100

4.6 Detail dimensions and creepage distances of open type bushings

4.6.1 General recommendations

The dimensions necessary for interchangeability of open type bushings shall be as specified in the following figures (Figure 2 up to Figure 7) and tables (Table 2 up to Table 13).

These figures do not purport to show constructional details. The provision for arcing horns should be made if required.

Customized bushings are subject to an agreement between purchaser and manufacturer.

As a special requirement, bushings of 36 kV can be ordered with metallization or equivalent of the flange collar with extension “M” in the designation. The creepage distance, as indicated in the different tables of this standard, will be reduced of approximately 100 mm.

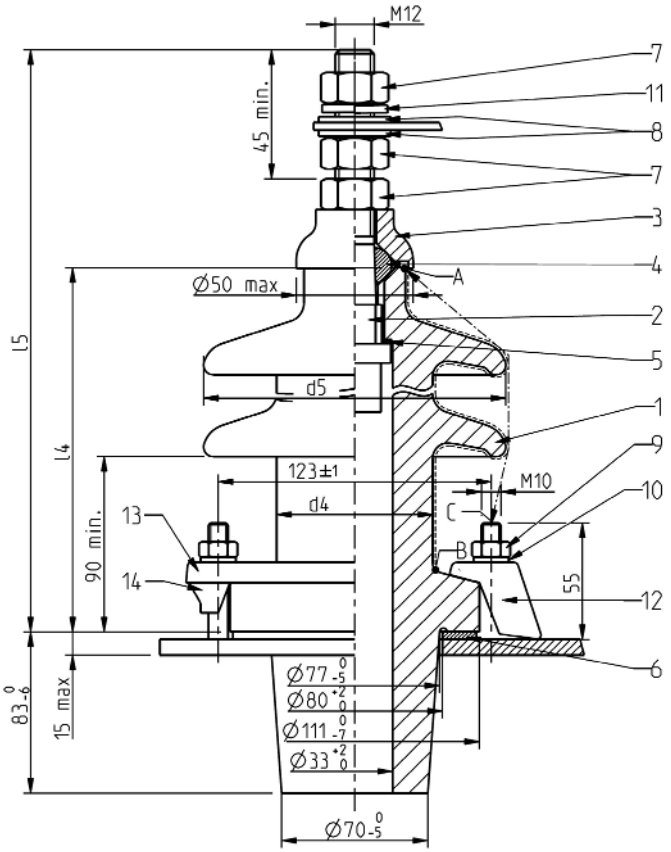
NOTE 52 kV bushings are always with metallization or equivalent solution.

4.6.2 250 A types 12 to 36 kV

Insulator types for 250 A may be clamped to the transformer tank using either the fixation method illustrated or a separate insulation piece on the inside of the tank.

This drawing does not purport to show constructional details.

All dimensions in mm



Key
← - - → arcing distance AC
· -------- · creepage distance AB

Figure 2 — 250 A types 12 to 36 kV

Table 2 — Dimensions, 250 A types 12 to 36 kV

Designation	U_m kV	Min. nominal creepage Distance AB (mm) Pollution level (IEC/TS 60815) b	c	d	e	Insulator type	Arcing Distance AC mm	l_4 max. mm	l_5 max. mm	d_4 max. mm	d_5 max. mm
12-250/P1 12-250/P2	12	192	240			1	145	190	270	75	140
12-250/P4 24-250/P2	12 24	384	480	300	372	2	260	304	384	80	150
24-250/P3 36-250/P1	24 36	576		600		3	315	357	437	80	155
24-250/P4 36-250/P3	24 36		720	900	744	4	465	516	596	80	155
36-250/P4	36				1 116	5	485	516	596	80	190

Table 3 — List of components, 250 A types 12 to 36 kV

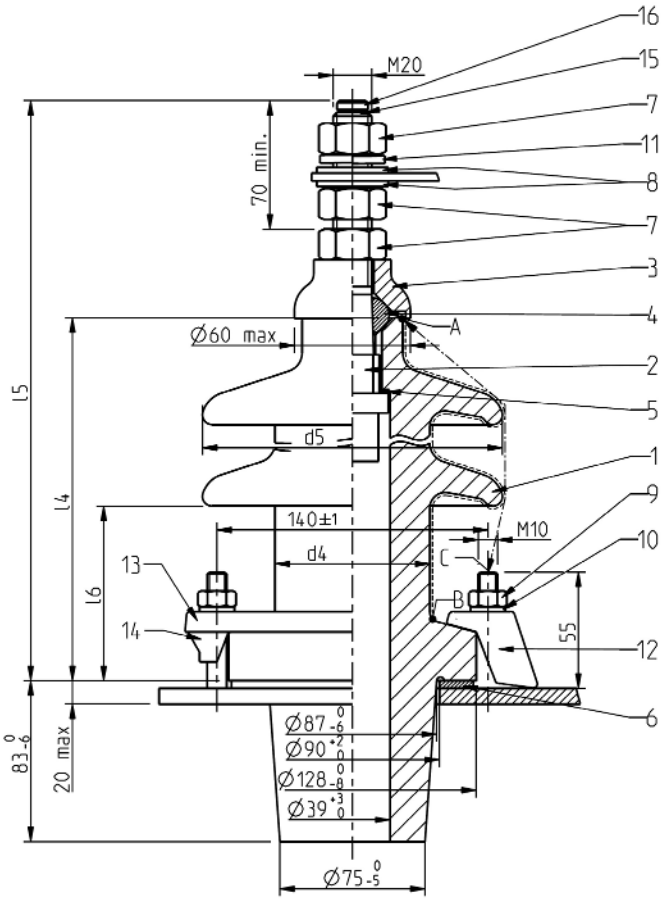
Item	Quantity 12-250/P1	12-250/P2	12-250/P4	24-250/P2	24-250/P3	24-250/P4	36-250/P1	36-250/P3	36-250/P4	Designation		Remarks
1	1	1								Insulator	Type 1	Porcelain
			1	1							Type 2	
					1		1				Type 3	
						1		1			Type 4	
									1		Type 5	
2	1									Terminal stud [a]		Brass
3	1									Cap [a]		Brass
4	1									Gasket [a]		Insulating liquid resistant material
5	1									Spacer [a]		
6	1									Packing [a]		Insulating liquid resistant material
7	3									Nut		Brass
8	2									Washer		Brass
9	As required									Nut		Corrosion-resistant
10	As required									Washer		Corrosion-resistant
11	1									Spring-washer		Corrosion-resistant
Variant A: by means of clamping pieces												
12	As required									Clamping piece [a]		Corrosion-resistant
Variant B: by means of clamping ring												
13	1									Clamping ring [a]		Corrosion-resistant
14	As required									Clamping paw [a]		Corrosion-resistant

[a] Constructional details are not covered by this standard.

4.6.3 630 A types 12 to 36 kV

This drawing does not purport to show constructional details.

All dimensions in mm



Key
← - - → arcing distance AC
· -------- · creepage distance AB

Figure 3 — 630 A types 12 to 36 kV

Table 4 — Dimensions, 630 A types 12 to 36 kV

Designation	U_m kV	Min. nominal creepage distance AB (mm) Pollution level (IEC/TS 60815) b	c	d	e	Inulator Type	Arcing distance AC mm	l_4 max. mm	l_5 max. mm	l_6 max. mm	d_4 max. mm	d_5 max. mm
12-630/P3	12	192	240	300		6	190	235	350	90	80	155
12-630/P4 24-630/P2	12 24	384	480		372	7	285	325	440	90	85	170
24-630/P4 36-630/P2	24 36	576	720	600	744	8	375	423	540	100	85	180
36-630/P4	36			900	1116	9	475	515	630	100	85	210

Table 5 — List of components - 630 A types 12 to 36 kV

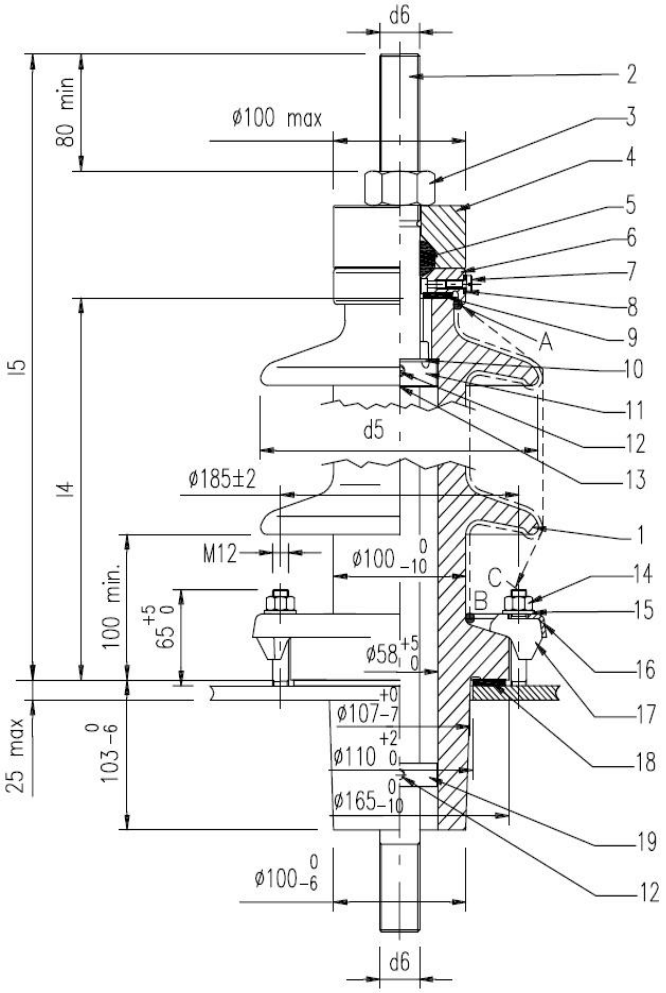
Item	Quantity						Designation		Remarks
	12-630/P3	12-630/P4	24-630/P2	24-630/P4	36-630/P2	36-630/P4			
1	1						Insulator	Type 6	Porcelain
		1	1					Type 7	
				1	1			Type 8	
						1		Type 9	
2	1						Terminal stud [a]		Brass
3	1						Cap [a]		Brass
4	1						Gasket [a]		Insulating liquid resistant material
5	1						Spacer [a]		
6	1						Packing [a]		Insulating liquid resistant material
7	3						Nut		Brass
8	2						Washer		Brass
9	As required						Nut		Corrosion-resistant
10	As required						Washer		Corrosion-resistant
11	1						Spring-washer		Corrosion-resistant
15	1						Gasket [a]		
16	1						Vent plug [a]		Brass
Variant A: by means of clamping pieces									
12	As required						Clamping piece [a]		Corrosion-resistant
Variant B: by means of clamping ring									
13	1						Clamping ring [a]		Corrosion-resistant
14	As required						Clamping paw [a]		Corrosion-resistant

[a] Constructional details are not covered by this standard.

4.6.4 1 250 A types 12 to 36 kV

This drawing does not purport to show constructional details; it shows only an example for bottom end connections. Other designs are acceptable.

All dimensions in mm



Key
← - - → arcing distance AC
· -------- · creepage distance AB

Figure 4 — 1 250 A types 12 to 36 kV

Table 6 — Dimensions, 1 250 A types 12 to 36 kV

Designation	U_m kV	Min. nominal creepage Distance AB (mm) Pollution level (IEC/TS 60815) b	c	d	e	Insulator Type	Arcing distance AB mm	l_4 max. mm	l_5 max. mm	d_5 max. mm	d_6 mm
12-1250/P4	12	192	240	300	372	21	215	260	415	210	M30 x 2
24-1250/P3	24	384	480	600		22	280	325	480	210	
24-1250/P4 36-1250/P3 36-1250/P3M	24 36 36	576	720	900	744	23 23 23M	385	420	575	240	
36-1250/P4 36-1250/P4M	36				1116	24 24M	500	535	690	240	

NOTE It is advised to refer to 4.6 for bushings with metallization or equivalent.

Table 7 — List of components, 1 250 A types 12 to 36 kV

Item	Quantity 12-1250/P4	24-1250/P3	24-1250/P4	36-1250/P3 (M)	36-1250/P4 (M)	Designation		Remarks
1	1					Insulator	Type 21	Porcelain
		1					Type 22	
			1	1			Type 23(M)	
					1		Type 24(M)	
2	1					Terminal stud [a]		Copper [b]
3	1					Nut [a]		Brass
4	1					Upper cap [a]		Brass
5	1					Sealing ring [a]		Insulating liquid resistant material
6	1					Lower cap [a]		Brass
7	1					Gasket [a]		
8	1					Vent plug [a]		Brass
9	1					Gasket [a]		Insulating liquid resistant material
10	1					Spacer [a]		
11	1					Compression ring [a]		Brass
12	As required					Screw with cone point [a]		
13	1					Ring [a]		Copper
14	As required					Nut		Corrosion-resistant
15	As required					Washer		Corrosion-resistant
16	1					Clamping ring [a]		Corrosion-resistant
17	As required					Clamping paw [a]		Corrosion-resistant
18	1					Gasket [a]		Insulating liquid resistant material
19	1					Conductor guide [a]		

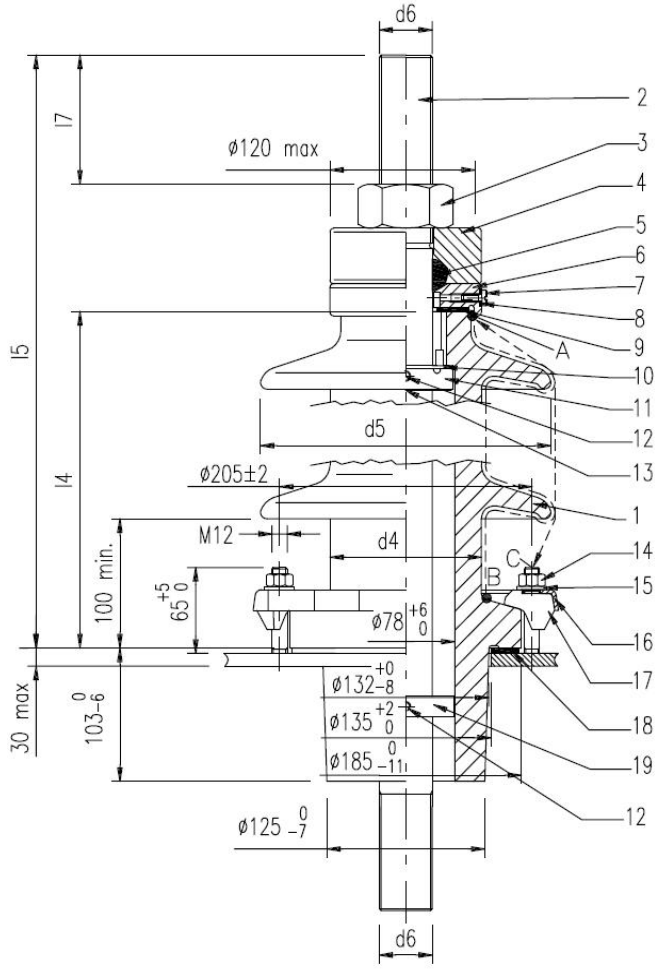
[a] Constructional details are not covered by this standard.

[b] If brass is used the rated current I_r shall be reduced subject to an agreement.

4.6.5 2 000 A – 3 150 A types 12 to 36 kV

This drawing does not purport to show constructional details; it shows only an example for bottom end connections. Other designs are acceptable.

All dimensions in mm



Key
← - - → arcing distance AC
· -------- · creepage distance AB

Figure 5 — 2 000 A – 3 150 A types 12 to 36 kV

Table 8 — Dimensions, 2 000 A – 3 150 A types 12 to 36 kV

Designation	U_m	Min. nominal creepage Distance AB (mm) Pollution (IEC/TS 60815) level				Insu - lator type	Arcing Distance AC	l_4 max.	l_5 max.	l_7 max.	d_4 max.	d_5 max.	d_6
	kV	b	c	d	e		mm	mm	mm	mm	mm	mm	mm
12-2000/P4 12-3150/P4	12	192	240 240	300 300	372 372	25	210	260	450 470	100 120	120	230	M42x3 M48x3
24-2000/P3 24-3150/P3	24	384	480 480	600 600		26	275	325	515 535	100 120	120	230	M42x3 M48x3
24-2000/P4 24-3150/P4	24				744 744	27			610 630	100 120			M42x3 M48x3
36-2000/P3 36-3150/P3	36	576	720	900		27	385	420	610 630	100 120	125	260	M42x3 M48x3
36-2000/P3M 36-3150/P3M						27 M			610 630	100 120			M42x3 M48x3
36-2000/P4 36-3150/P4	36				1116	28	495	535	725 745	100 120	125	260	M42x3 M48x3
36-2000/P4M 36-3150/P4M						28 M			725 745	100 120			M42x3 M48x3

NOTE It is advised to refer to 4.6 for bushings with metallization or equivalent.

Table 9 — List of components 2 000 A – 3 150 A types 12 to 36 kV

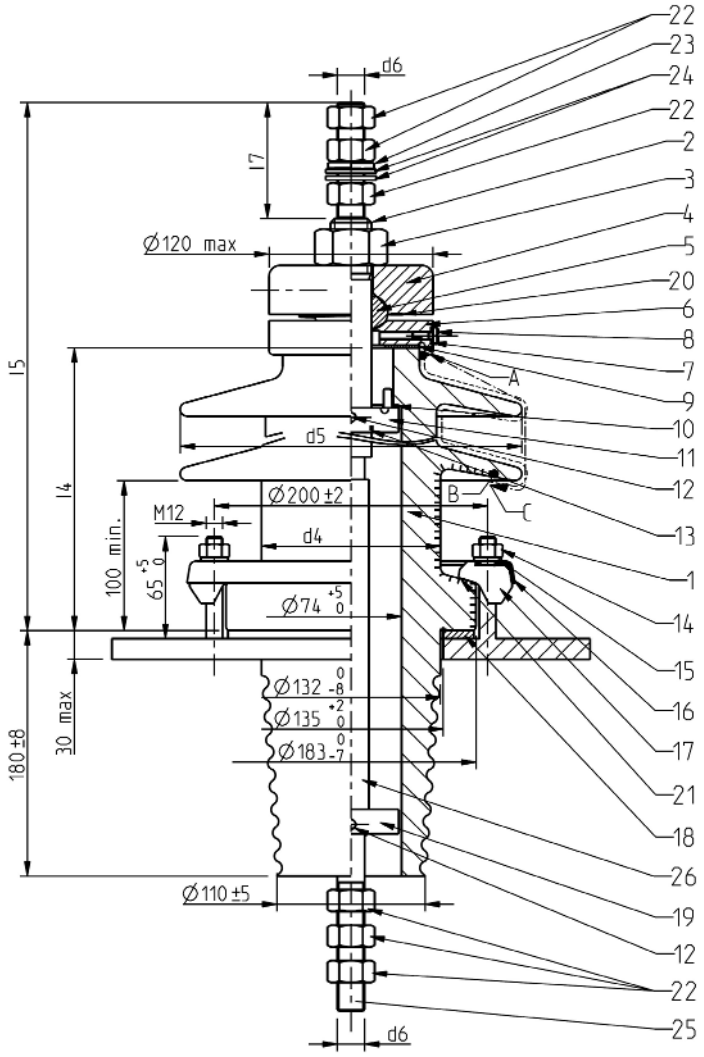
Item	Quantity					Designation		Remarks
	12-2000/P4 12-3150/P4	24-2000/P3 24-3150/P3	24-2000/P4 24-3150/P4	36-2000/P3 (M) 36-3150/P3 (M)	36-2000/P4 (M) 36-3150/P4 (M)			
1	1					Insulator	Type 25	Porcelain
		1					Type 26	
			1	1			Type 27(M)	
					1		Type 28(M)	
2	1					Terminal stud [a]		Copper [b]
3	1					Nut [a]		Brass
4	1					Upper cap [a]		Brass
5	1					Sealing ring [a]		Insulating liquid resistant material
6	1					Lower cap [a]		Brass
7	1					Gasket [a]		
8	1					Vent plug [a]		Brass
9	1					Gasket [a]		Insulating liquid resistant material
10	1					Spacer [a]		
11	1					Compression ring [a]		Brass
12	As required					Screw with cone point [a]		
13	1					Ring [a]		Copper
14	As required					Nut		Corrosion-resistant
15	As required					Washer		Corrosion-resistant
16	1					Clamping ring [a]		Corrosion-resistant
17	As required					Clamping paw [a]		Corrosion-resistant
18	1					Gasket [a]		Insulating liquid resistant material
19	1					Conductor guide [a]		

[a] Constructional details are not covered by this standard.
[b] If brass is used the rated current I_r shall be reduced subject to an agreement.

4.6.6 250 A – 630 A types 52 kV

This drawing does not purport to show constructional details; it shows only an example for bottom end connections. Other designs are acceptable.

All dimensions in mm



Key
Surface marked with _|_|_|_|_|_| are metalized

←- - → arcing distance AC
· -------- · creepage distance AB

Figure 6 — 250 A – 630 A types 52 kV

Table 10 — Dimensions, 250 A - 630 A types 52 kV

Designation	U_m kV	Min. nominal creepage Distance AB mm Pollution level (IEC/TS 60815) b	c	d	e	Insu-lator type	Arcing Distance AC mm	l_4 max. mm	l_5 max. mm	l_7 max. mm	d_4 max. mm	d_5 max. mm	d_6 mm
52-250/P1 52-630/P1	52	832				29	480	505	660	60	136	259	M12
									685	85			M20
52-250/P3 52-630/P3	52	832	1 040	1 300		30	480	505	660	60	136	259	M12
									685	85			M20
52-250/P4 52-630/P4	52	832	1 040	1 300	1 612	31	520	550	705	60	136	259	M12
									730	85			M20

Table 11 — List of components 250 A - 630 A types 52 kV

Item	Quantity 52-250/P1 52-630/P1	52-250/P3 52-630/P3	52-250/P4 52-630/P4	Designation		Remarks
1	1			Insulator	Type 29	Porcelain
		1			Type 30	
			1		Type 31	
2	1			Terminal stud [a]		Brass for 250 A Copper for 630 A [b]
3	1			Nut [a]		Brass
4	1			Upper cap [a]		Brass
5	1			Sealing ring [a]		Insulating liquid resistant material
6	1			Lower cap [a]		Brass
7	1			Gasket [a]		
8	1			Vent plug [a]		Brass
9	1			Gasket [a]		Insulating liquid resistant material
10	1			Spacer [a]		
11	1			Compression ring [a]		Brass
12	As required			Screw with cone point [a]		
13	1			Ring [a]		Copper
14	As required			Nut		Corrosion-resistant
15	As required			Washer		Corrosion-resistant
16	1			Clamping ring [a]		Corrosion-resistant
17	As required			Clamping paw [a]		Corrosion-resistant
18	1			Gasket [a]		Insulating liquid resistant material
19	1			Conductor guide [a]		
20	1			Contact ring [a]		Copper
21	1			Adjusting ring [c]		Copper
22	6			Nut		Brass
23	1			Spring-washer		Corrosion-resistant
24	2			Washer		Brass
25	1			Lower bolt		Brass
26	1			Insulating tube		

[a] Constructional details are not covered by this standard.

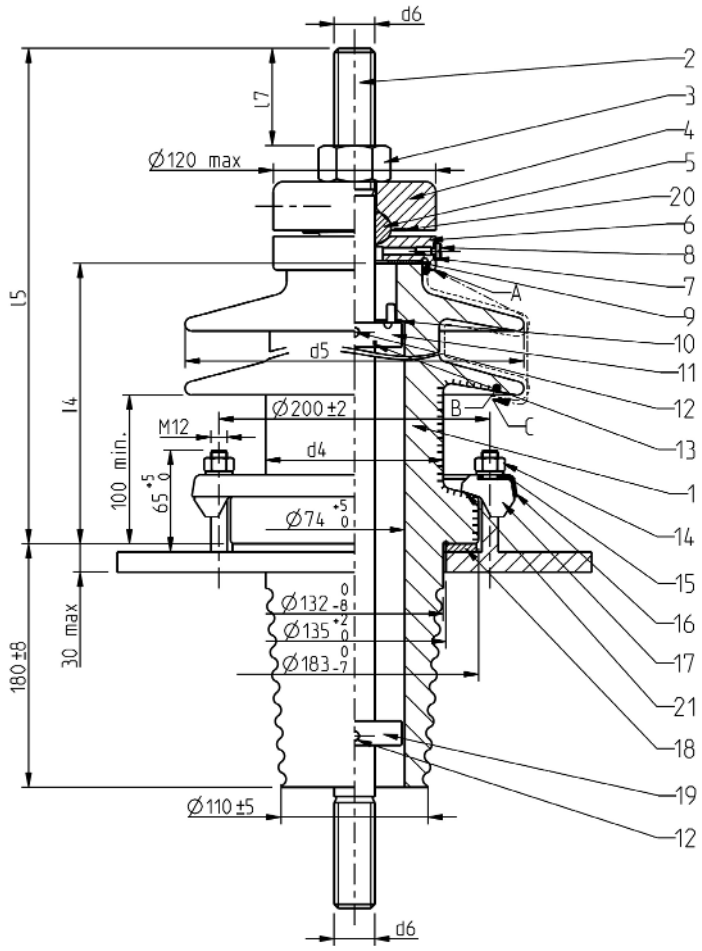
[b] If brass is used the rated current I_r shall be reduced subject to an agreement.

[c] See constructional details as in Figure A.21.

4.6.7 1 250 A– 2 000 A – 3 150 A types 52 kV

This drawing does not purport to show constructional details; it shows only an example for bottom end connections. Other designs are acceptable.

All dimensions in mm



Surface marked with _|_|_|_|_|_| are metalized

← - - → arcing distance AC
· -------- · creepage distance AB

Figure 7 — 1 250 A – 2 000 A – 3 150 A types 52 kV

Table 12 — Dimensions, 1 250 A – 2 000 A – 3 150 A types 52 kV

Designation	U_m kV	Min. nominal creepage Distance AB (mm) Pollution level (IEC/TS 60815) b	c	d	e	Insu-lator type	Arcing Distance AC mm	l_4 max. mm	l_5 max. mm	l_7 max. mm	d_4 max. mm	d_5 max. mm	d_6 mm
52-1250/P1 52-2000/P1 52-3150/P1	52	832				29	480	505	655	65	136	259	M30X2
									685	85			M42X3
									690				M48x3
52-1250/P3 52-2000/P3 52-3150/P3	52	832	1 040	1 300		30	480	505	655	65	136	259	M30x2
									685	85			M42X3
									690				M48X3
52-1250/P4 52-2000/P4 52-3150/P4	52	832	1 040	1 300	1 612	31	520	550	700	65	136	259	M30x2
									730	85			M42x3
									735				M48x3

Table 13 — List of components 1 250 A – 2000 A – 3 150 A types 52 kV

Item	Quantity 52-1250/P1 52-2000/P1 52-3150/P1	Quantity 52-1250/P3 52-2000/P3 52-3150/P3	Quantity 52-1250/P4 52-2000/P4 52-3150/P4	Designation		Remarks
1	1			Insulator	Type 29	Porcelain
		1			Type 30	
			1		Type 31	
2	1			Terminal stud [a]		Copper [b]
3	1			Nut [a]		Brass
4	1			Upper cap [a]		Brass
5	1			Sealing ring [a]		Insulating liquid resistant material
6	1			Lower cap [a]		Brass
7	1			Gasket [a]		
8	1			Vent plug [a]		Brass
9	1			Gasket [a]		Insulating liquid resistant material
10	1			Spacer [a]		
11	1			Compression ring [a]		Brass
12	As required			Screw with cone point [a]		
13	1			Ring [a]		Copper
14	As required			Nut		Corrosion-resistant
15	As required			Washer		Corrosion-resistant
16	1			Clamping ring [a]		Corrosion-resistant
17	As required			Clamping paw [a]		Corrosion-resistant
18	1			Gasket [a]		Insulating liquid resistant material
19	1			Conductor guide [a]		
20	1			Contact ring [a]		Copper
21	1			Adjusting ring [c]		Copper

[a] Constructional details are not covered by this standard.

[b] If brass is used the rated current I_r shall be reduced subject to an agreement.

[c] See constructional details as in Figure A.21.

4.7 Detail dimensions of plug-in type bushings

4.7.1 General

The dimensions necessary for interchangeability of plug-in type bushings and for compatibility with mating separable connectors are as specified in the following figures and tables.

These figures do not purport to show constructional details.

4.7.2 Outside cone type

The dimensions for outside cone plug-in bushings are specified in Figures 8a, 8b and 9 and in Tables 14 and 15.

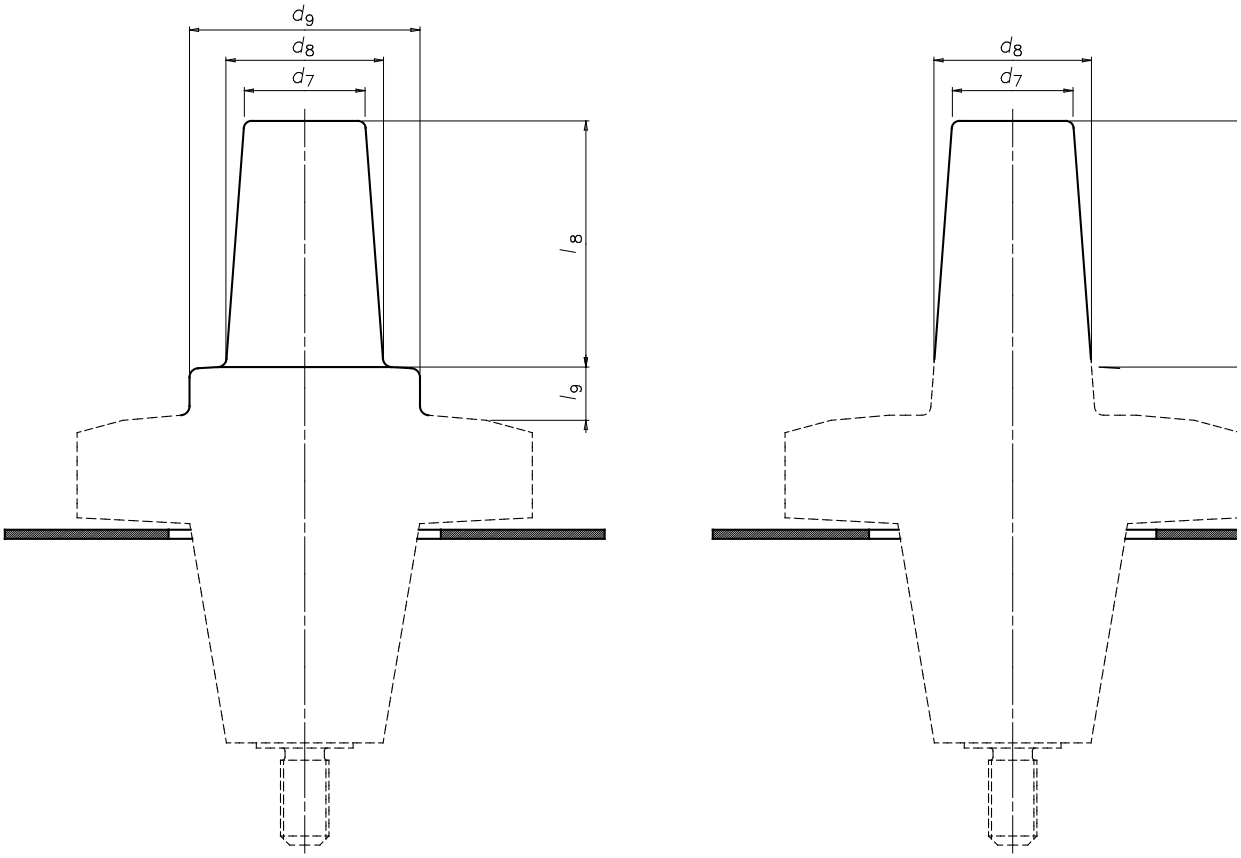


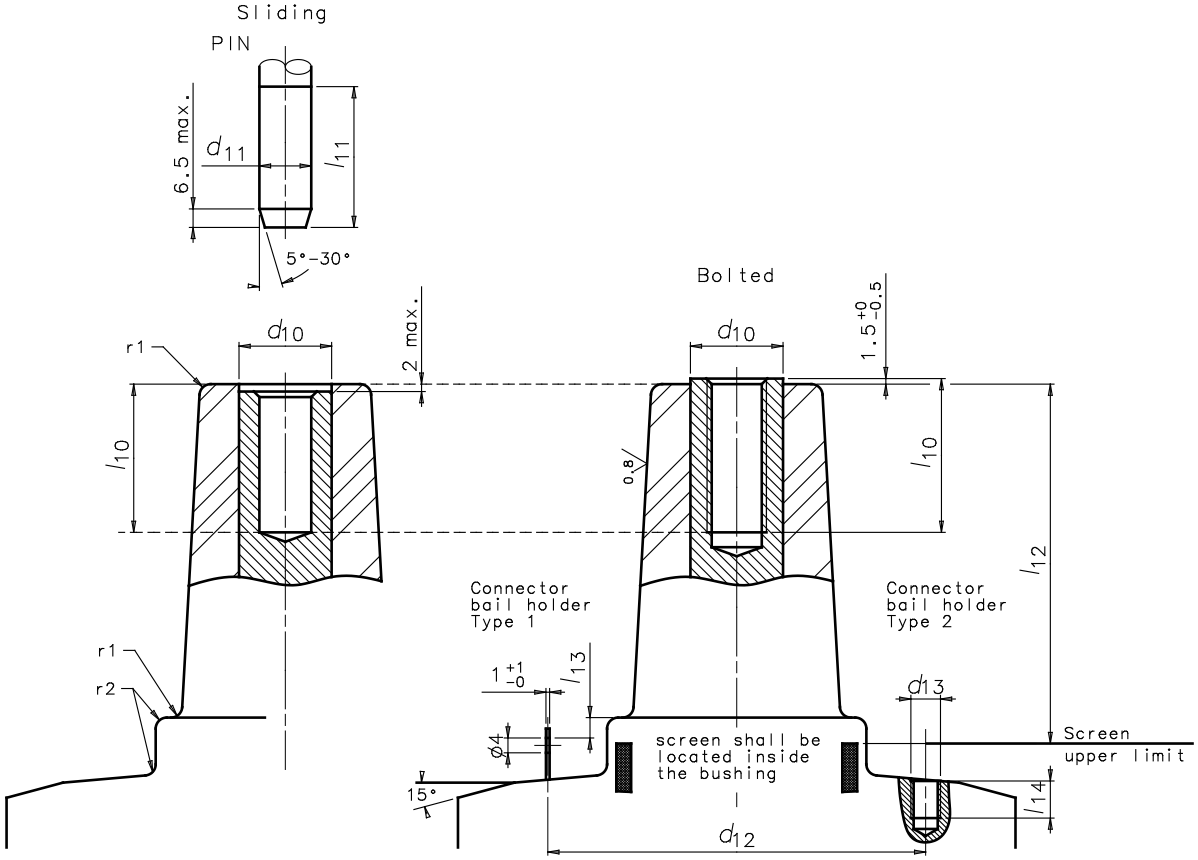
Figure 8 — Outside cone plug-in type bushings

Table 14 — Interface dimensions

U_m kV	I_r A	d_7 mm	d_8 ±0,2 mm	d_9 ±0,2 mm	l_8 mm	l_9 min. mm	Contact type	Interface type	Fig.
12-24	**250**	$31^{+0,1}_{-0,3}$	32,5	48,5	$48^{0}_{-0,2}$	9	Sliding	A	8.1
12-24-36	**250 - 400**	46 ± 0,2	56	70	90 ± 0,2	11	Sliding	B	8.1
12-24-36	**630-1 250**	46 ± 0,2	56	70	90 ± 0,2	11	Bolted	C	8.1
12-24	**800-1 250**	39,9 ± 0,2	52,1	76,2	81 ± 0,2	14,8	Bolted	D	8.1
36		39,9 ± 0,2	61,5	76,2	103,7 ± 0,2	21	Bolted	E	8.1
12-24-36	**630-1 250 2 500**	64 ± 0,2	86,8		110,5 ± 0,2		Bolted	F	8.2
12-24-36-52	**630-1 250**								

Interface type: A to E

All dimensions in mm



Interface type: F

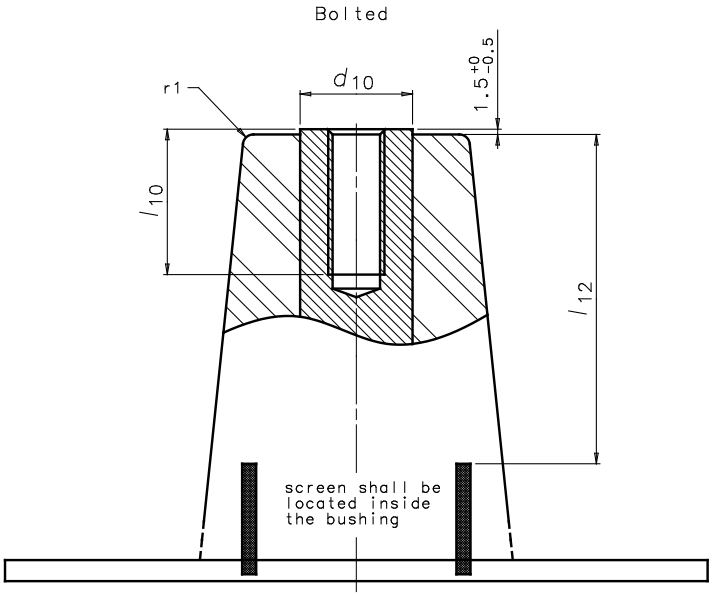


Figure 9 - Details of outside cone plug-in type bushings

Table 15 — Bushing dimensions

U_m	I_r	Bushing contact						l_{11}	l_{12}	Radius		Bail holder Type 1 or 2			l_{13}	l_{14}	**Interface and bushing type**
		Type	Material [a]	d_{10} nominal	d_{11}	Thread	l_{10} min.	min.	max.	r_1 max.	r_2 max.	Location d_{12} ± 0,5	Required number min.	d_{13} Type 2	± 2	min.	
kV	A			mm	mm		mm	mm	mm	mm	mm	mm			mm	mm	
12-24	**250**	Sliding	Cu	-	+0,02 7,9 -0,05	-	32	30	54	1	2x 45°	90	2	M6	3,5	8	**A1**
12-24-36	**250**	Sliding	Cu	-	+0 14 -0,04	-	40	38	97	3	3	102	2	M8	5,5	10	**B1**
12-24-36	**400**	Sliding	Cu	-	+0 14 -0,04	-	40	38	97	3	3	102	2	M8	5,5	10	**B2**
12-24-36	**630**	Bolted	Cu	22 min.	-	M 16	29	-	97	3	3	[b] 102	[b] 2	[b] M8	-	10	**C1**
12-24-36	**1 250**	Bolted	Cu	32	-	M 16	29	-	97	3	3	[b] 102	[b] 2	[b] M8	-	10	**C2**
12-24	**800**	Bolted	Cu or Al	32	-	M 16	29		88	3	3	[b] 102	[b] 2	[b] M8	-	10	**D1**
36									111								**E1**
12-24	**1 250**	Bolted	Cu	32	-	M 16	29	-	88	3	3	[b] 123	[b] 2	[b] M8	-	10	**D2**
36									111								**E2**
12-24-36	**2 500**	Bolted	Cu	50	-	M 16	29	-	94	3	-	-	-	-	-	-	**F1**
12-24-36-52	**630**	Bolted	Cu	22 min.	-	M 16	29	-	94	3	-	-	-	-	-	-	**F2**
12-24-36-52	**1 250**	Bolted	Cu	32	-	M 16	29	-	94	3	-	-	-	-	-	-	**F3**

[a] In the connection of separable connectors to bushings, care shall be taken in the matching of the materials of the cable conductors, the cable lugs and the bushing conductors. Where dissimilar metals are joined, appropriate precautions shall be taken.

Where aluminium bushing conductors are used and screw threads are required, a suitable grade of aluminium or aluminium alloy shall be used.

[b] Bail holder is optional.

4.7.3 Inside cone type

The dimensions fore inside cone Plug-in type bushings are specified in Figure 10 and 11 and in Tables 16 and 17.

All dimensions in mm

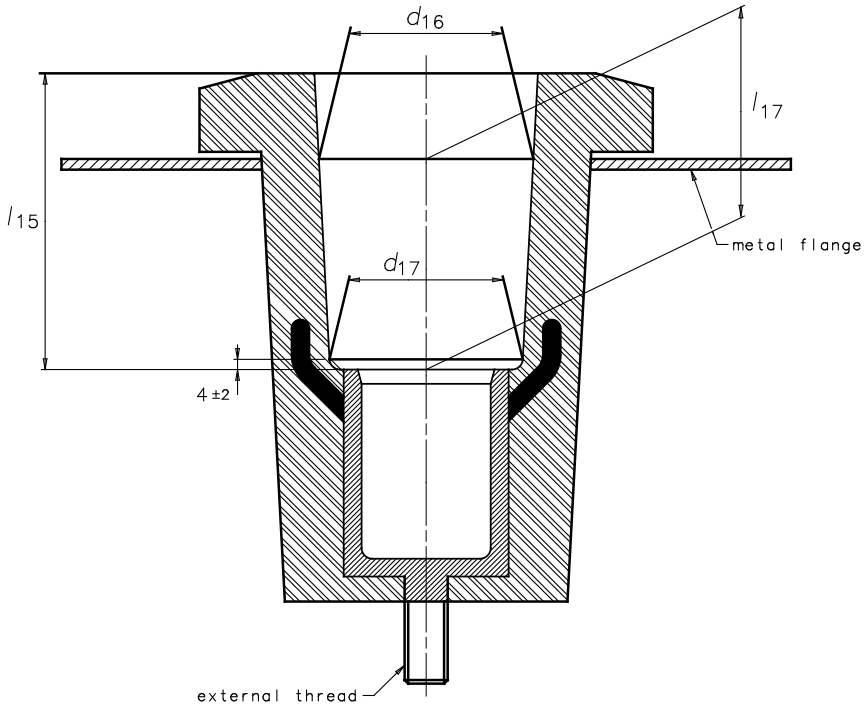


Figure 10 — Inside cone plug-in type bushings

Table 16 — Interface dimensions

U_m	I_r	d_{16} ± 0,4	d_{17} ± 0,4	l_{15} ± 1,3	l_{17} ± 0,2	Interface type
kV	A	mm	mm	mm	mm	
12-24	**250**	53,2	47,5	83	59	0
12-24-36	**400 - 630**	59,8	54	83	59	1
12-24-36	**800**	65,8	60	83	59	2
12-24-36-52	**1 250**	87,8	79,7	110	81	3

All dimensions in mm

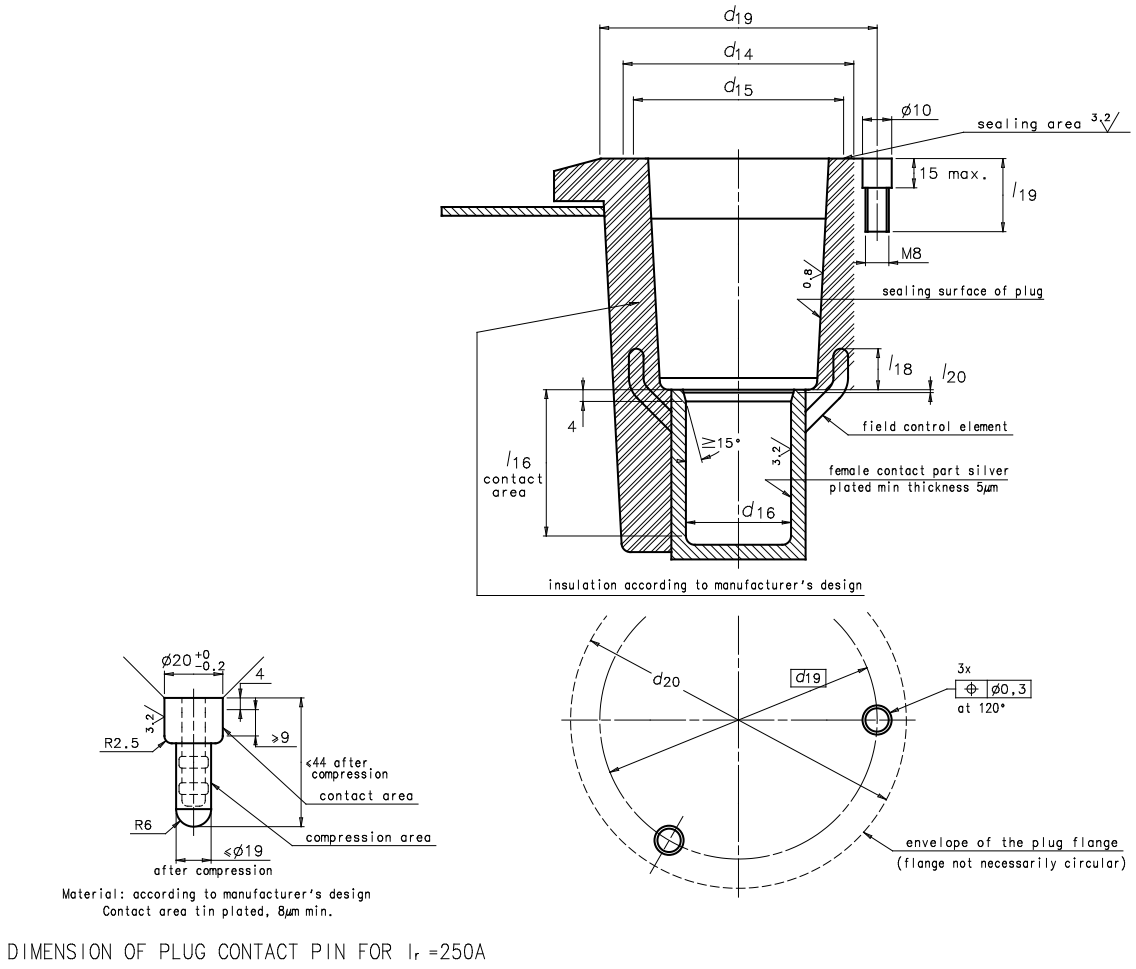


Figure 11 — Details of inside cone plug-in type bushings

Table 17 — Interface dimensions

U_m	I_r	d_{14}	d_{15}	d_{16} + 0,1 0	d_{19}	d_{20} max.	l_{16} min.	l_{18} + 2 -1	l_{19} + 5 0	l_{20}	Contact type	Interface type
kV	A	mm	mm	mm	mm	mm	mm	mm	mm	mm		
12-24	**250**	min 69	max 62	[a]	88	108	44	14	23	+1 1 -0,5	Sliding	0
12-24-36	**400 630**	min 79	max 72	36	95	115	46,5	14	23	0	Sliding	1
12-24-36	**800**	min 86	max 79	39	102	122	46,5	14	23	0	Sliding	2
12-24-36-52	**1 250**	0 115 -18	0 95 -1	55	130	150	82	19	32	0	Sliding	3

[a] The female part has to be designed according to the requirements of the separable connector contact pin detail.

Annex A
(normative)

Detail drawings of porcelain

A.1 12-24-36 kV / 250 A insulators

All dimensions in mm.
Unless otherwise stated in the drawing tolerances according to EN 62155

Material: Porcelain complying with C 100 series of EN 60672-3 or equivalent material
Color: Brown (other colors are allowed by special agreement)
Surface: Glazed except machined surfaces, ground surface and surfaces marked by -¨-¨-¨-¨- (other kind of surface for inner hole and lower extremity by special agreement).

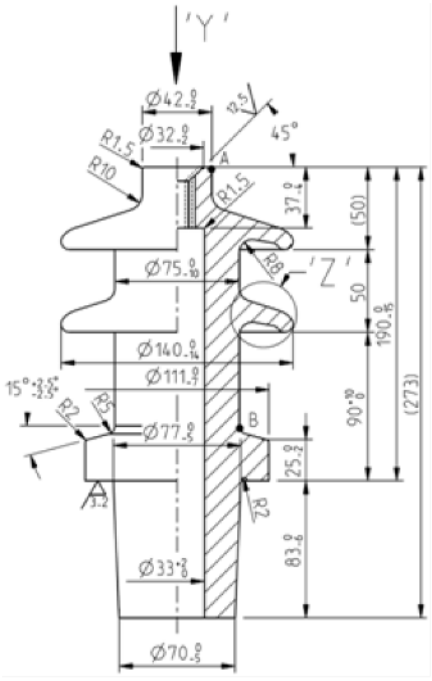


Figure A.1 — Insulator (item N°.1), type 1
Calculated nominal creepage distance AB of represented insulator 260 mm

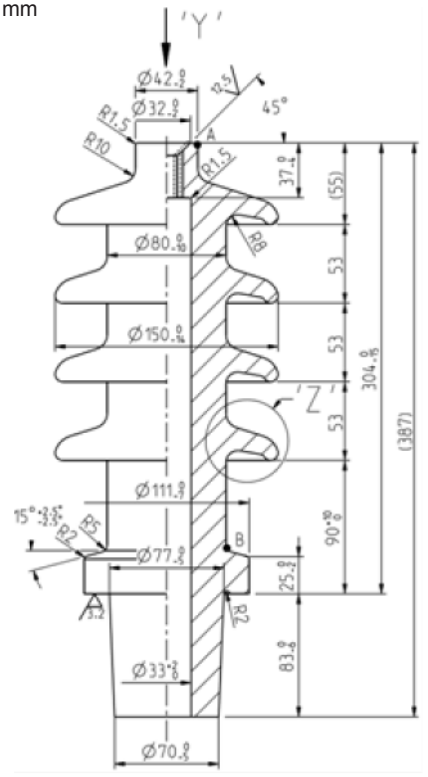


Figure A.2 — Insulator (Item n°1), type 2
Calculated nominal creepage distance AB of represented insulator 490 mm

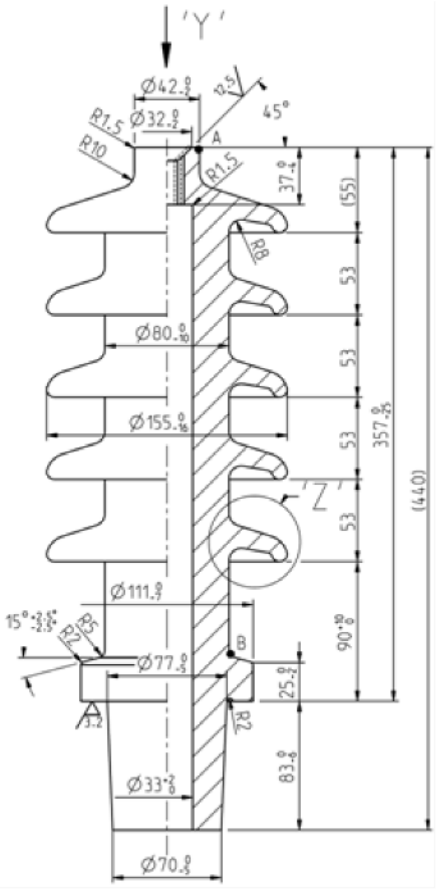
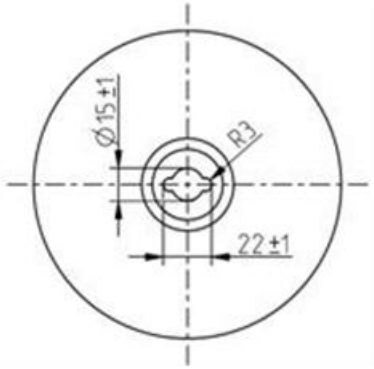


Figure A.3 — Insulator (Item n°1), type 3
Calculated nominal creepage distance AB of represented insulator 605 mm

Detail 'Z' see next page

View 'Y'



Material: Porcelain complying with C 100 series of EN 60672-3 or equivalent material
Color: Brown (other colors are allowed by special agreement)
Surface: Glazed except machined surfaces, ground surface and surfaces marked by -¨-¨-¨-¨- (other kind of surface for inner hole and lower extremity by special agreement).

1

All dimensions in mm.
Unless otherwise stated in the drawing tolerances according to EN 62155

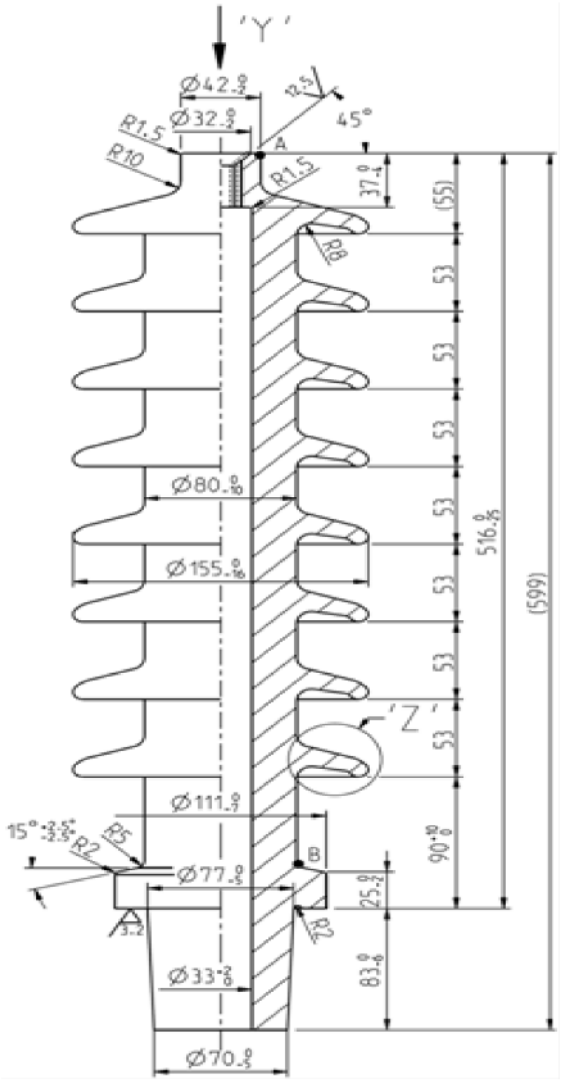


Figure A.4 — Insulator (Item n°1), type 4

Calculated nominal creepage distance AB of represented insulator 935 mm

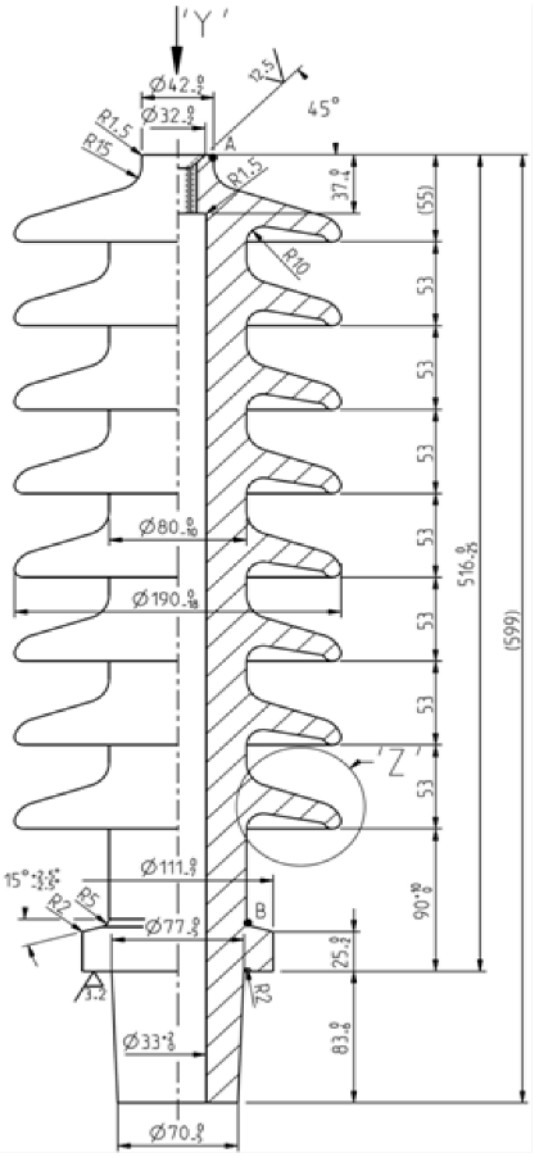
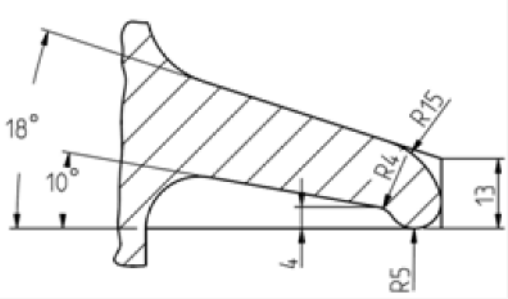


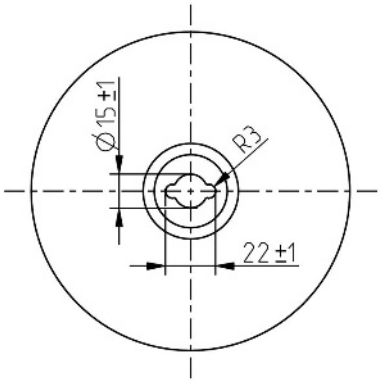
Figure A.5 — Insulator (Item n°1), type 5

Calculated nominal creepage distance AB of represented insulator 1 165 mm.

Detail 'Z'



View 'Y'



A.2 12-24-36 kV / 630 A insulators

Material: Porcelain complying with C 100 series of EN 60672-3 or equivalent material
Color: Brown (other colors are allowed by special agreement)
Surface: Glazed except machined surfaces, ground surface and surfaces marked by -¨-¨-¨-¨- (other kind of surface for inner hole and lower extremity by special agreement).

All dimensions in mm.
Unless otherwise stated in the drawing tolerances according to EN 62155

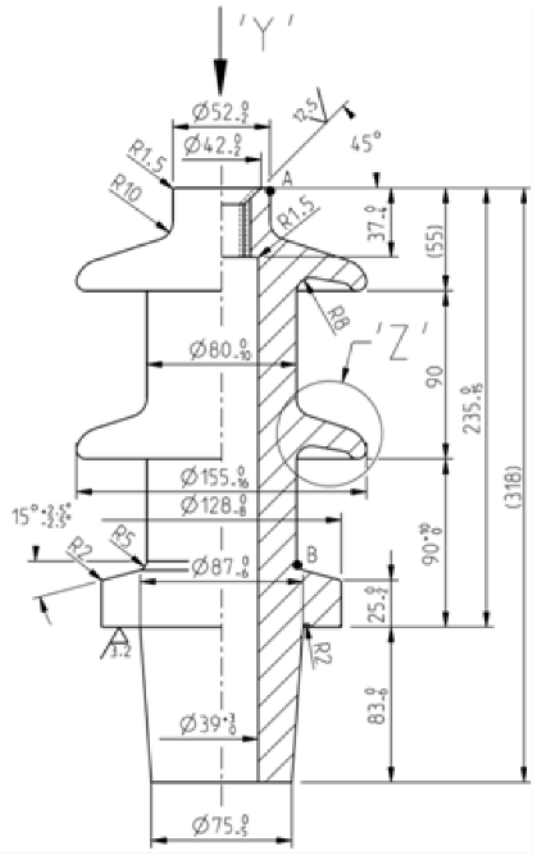


Figure A.6 — Insulator (Item n°1), type 6
Calculated nominal distance AB of represented insulator 315 mm

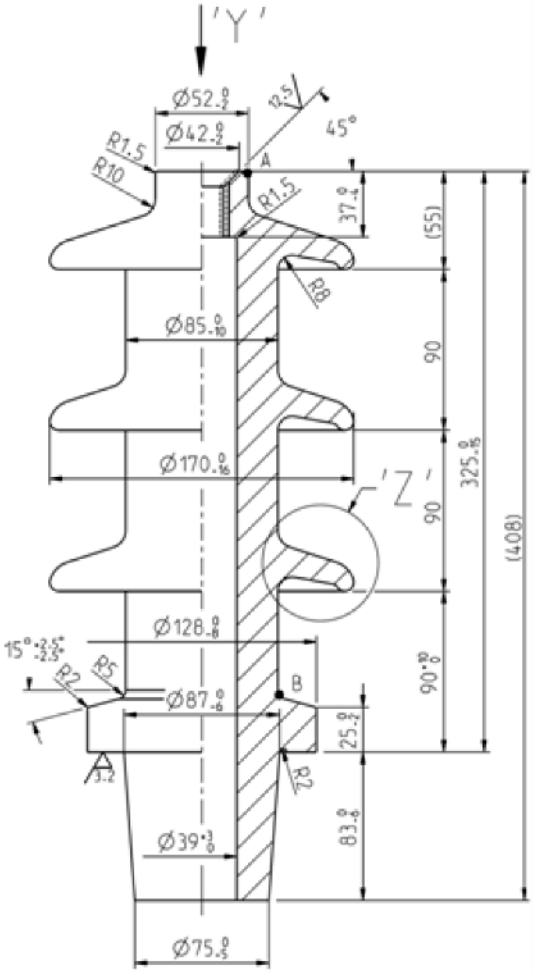
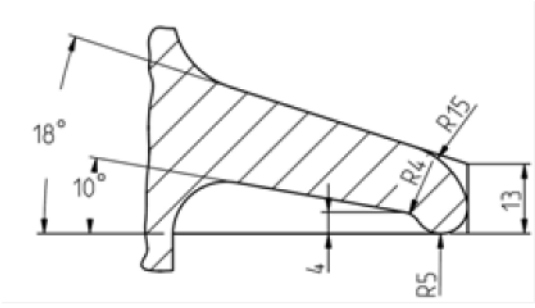
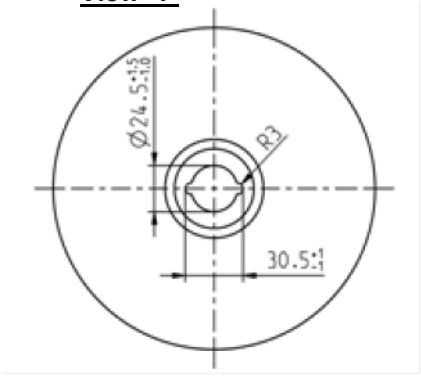


Figure A.7 — Insulator (Item n°1), type 7
Calculated nominal creepage distance AB of represented insulator 490 mm

Detail 'Z'



View 'Y'



Material: Porcelain complying with C 100 series of EN 60672-3 or equivalent material
Color: Brown (other colors are allowed by special agreement)
Surface: Glazed except machined surfaces, ground surface and surfaces marked by -·-·-·-·- (other kind of surface for inner hole and lower extremity by special agreement).

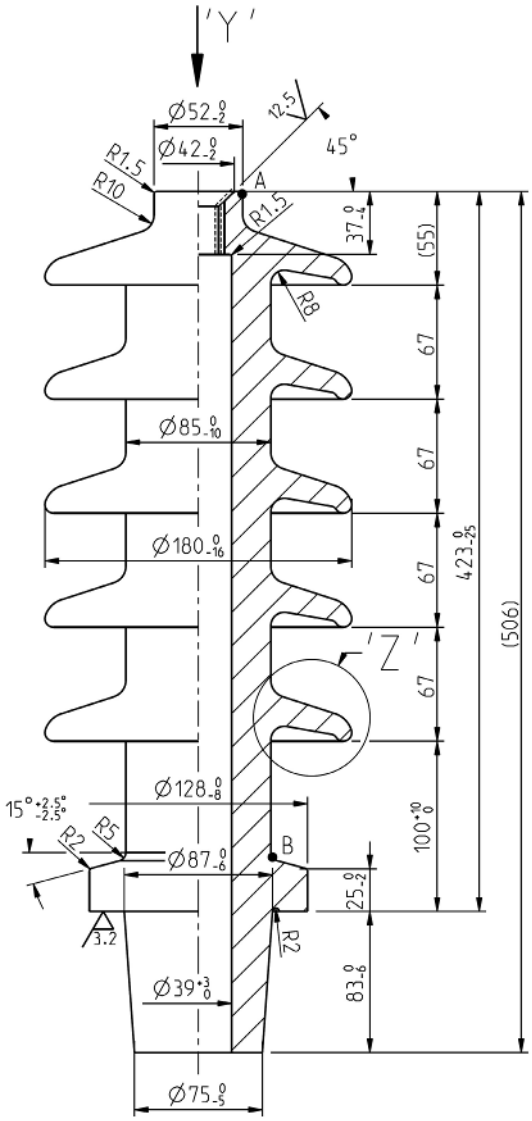


Figure A.8 — Insulator (Item n°1), type 8
Calculated nominal distance AB of represented insulator 760 mm

All dimensions in mm.
Unless otherwise stated in the drawing tolerances according to EN 62155

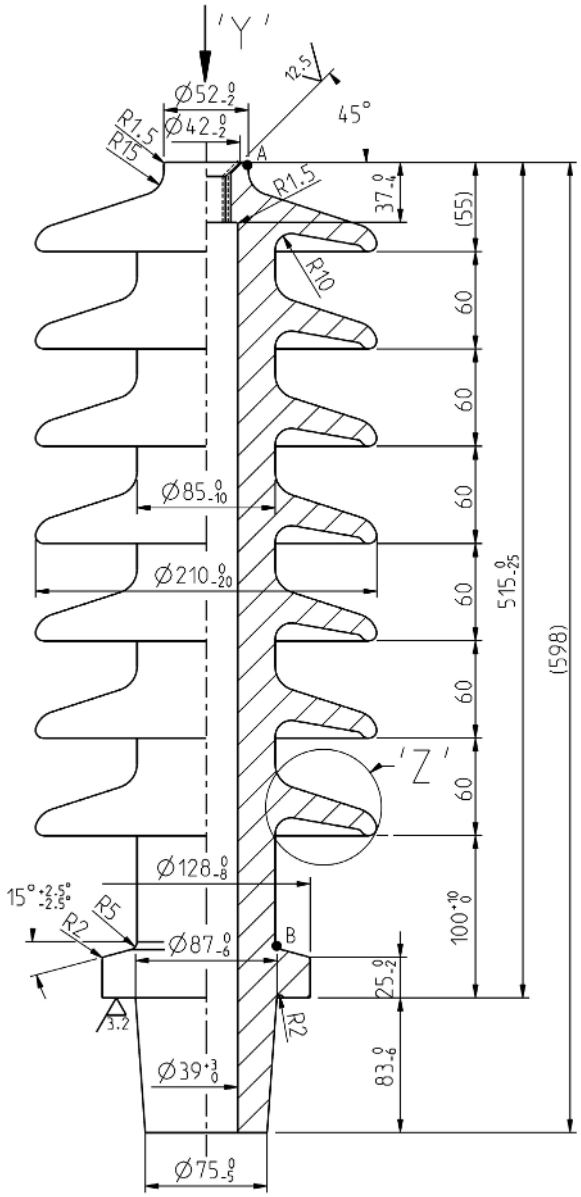
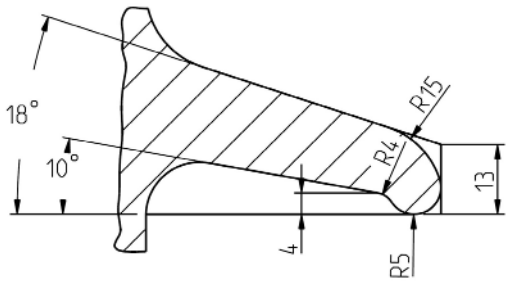
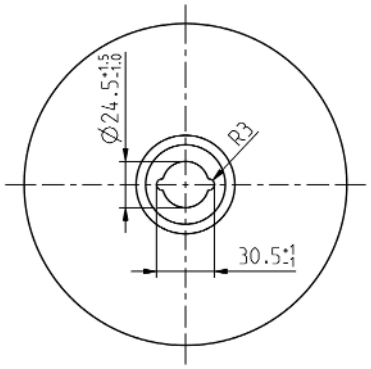


Figure A.9 — Insulator (Item n°1), type 9
Calculated nominal creepage distance AB of represented insulator 1155 mm.

Detail 'Z'



View 'Y'



A.3 12-24-36 kV / 1250 A insulators

Material: Porcelain complying with C 100 series of EN 60672-3 or equivalent material
Color: Brown (other colors are allowed by special agreement)
Surface: Glazed except machined surfaces, ground surface and surfaces marked by -·-·-·-·- (other kind of surface for inner hole and lower extremity by special agreement).

All dimensions in mm.
Unless otherwise stated in the drawing tolerances according to EN 62155

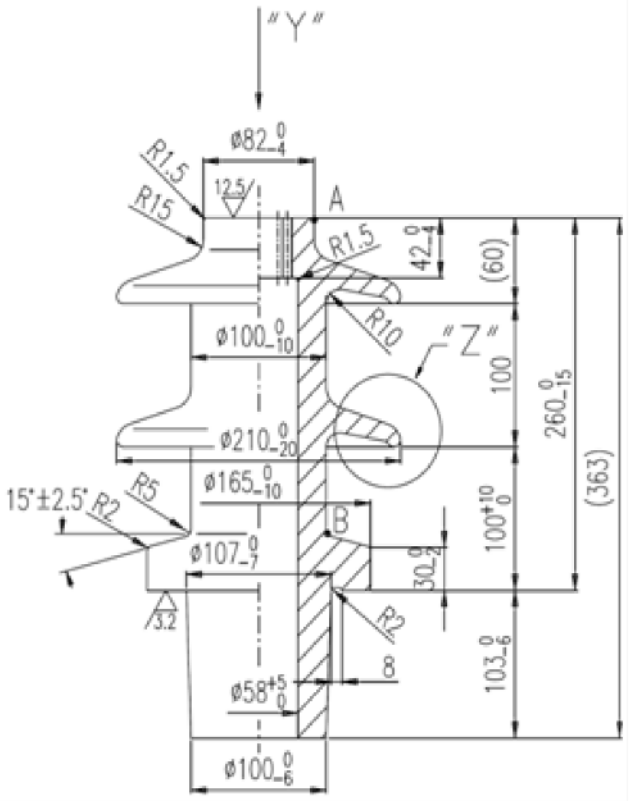


Figure A.10 — Insulator (Item n°1), type 21
Calculated nominal distance AB of represented insulator 385 mm

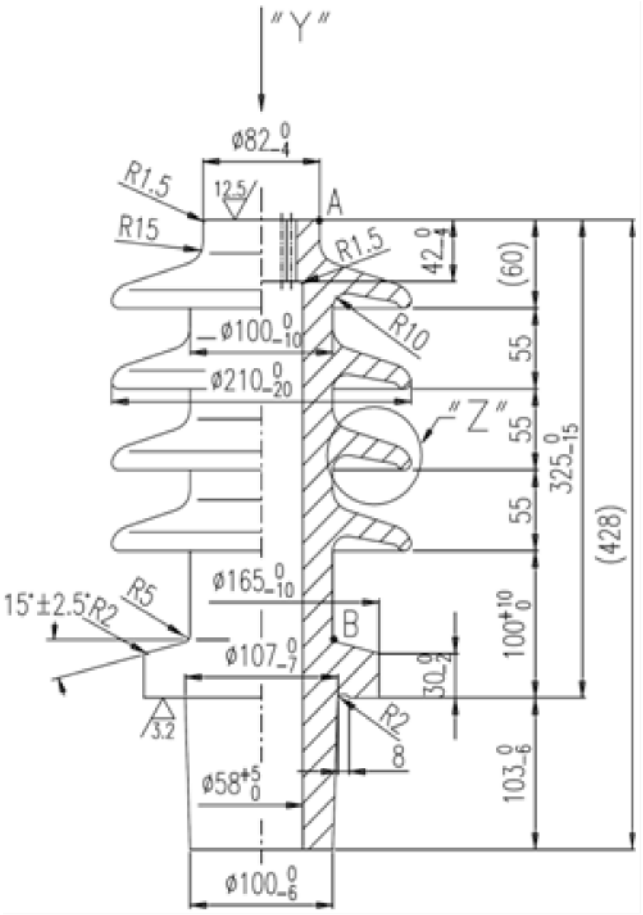
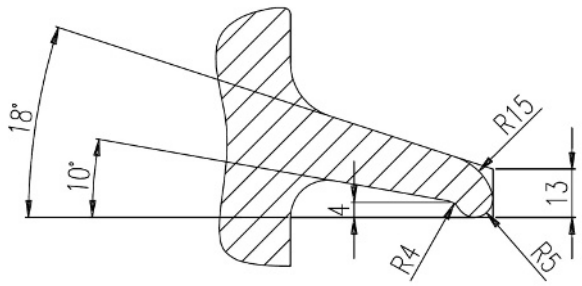
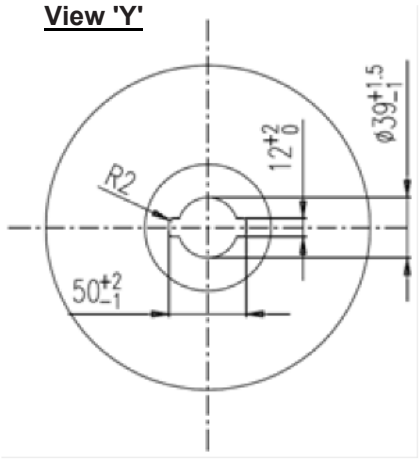


Figure A.11 — Insulator (Item n°1), type 22
Calculated nominal creepage distance AB of represented 620 mm

Detail 'Z'



View 'Y'



Material: Porcelain complying with C 100 series of EN 60672-3 or equivalent material
Color: Brown (other colors are allowed by special agreement)
Surface: Glazed except machined surfaces, ground surface and surfaces marked by -·-·-·-·- (other kind of surface for inner hole and lower extremity by special agreement).

All dimensions in mm.
Unless otherwise stated in the drawing tolerances according to EN 62155

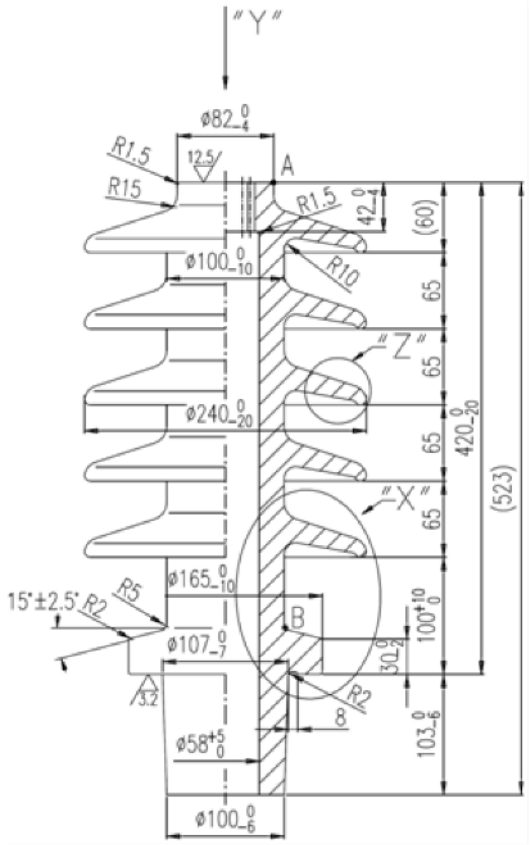


Figure A.12 — Insulator (Item n°1), type 23 & 23M
Calculated nominal distance AB of represented insulator 930 mm

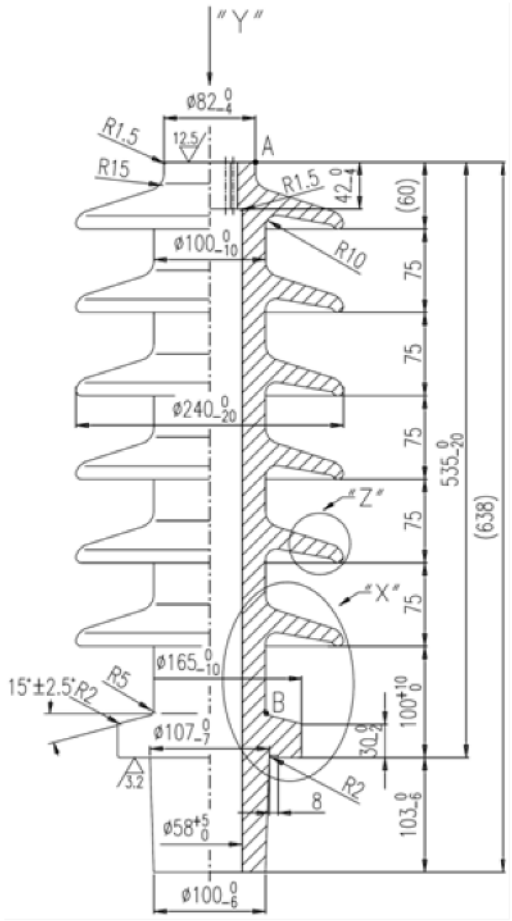
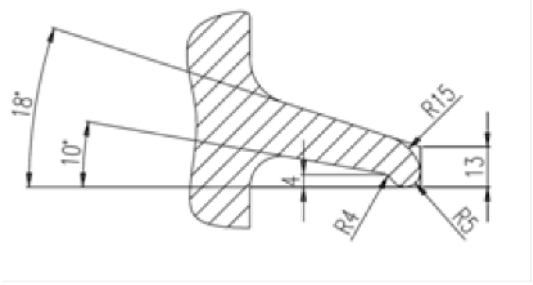
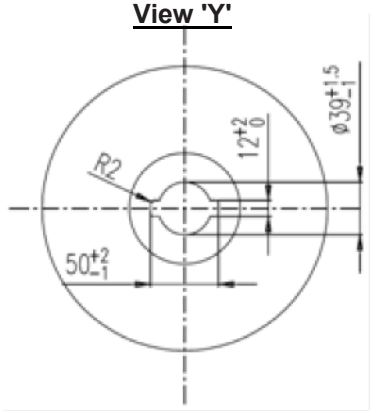


Figure A.13 — Insulator (Item n°1), type 24 & 24M
Calculated nominal creepage distance AB of represented insulator 1 145 mm

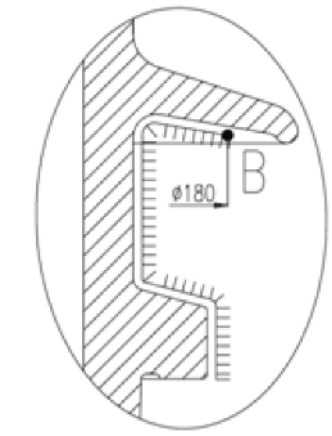
Detail 'Z'



View 'Y'



Detail 'X'
Only on models 23M and 24M



NOTE The same porcelain with metallization are named type 23M and 24M.
Calculated nominal creepage distances: for 23M is 830 mm and for 24M is 1045 mm.

A.4 12-24-36 kV / 2000 - 3150 A insulators

Material: Porcelain complying with C 100 series of EN 60672-3 or equivalent material
Color: Brown (other colors are allowed by special agreement)
Surface: Glazed except machined surfaces, ground surface and surfaces marked by -·-·-·-·- (other kind of surface for inner hole and lower extremity by special agreement).

All dimensions in mm.
Unless otherwise stated in the drawing tolerances according to EN 62155

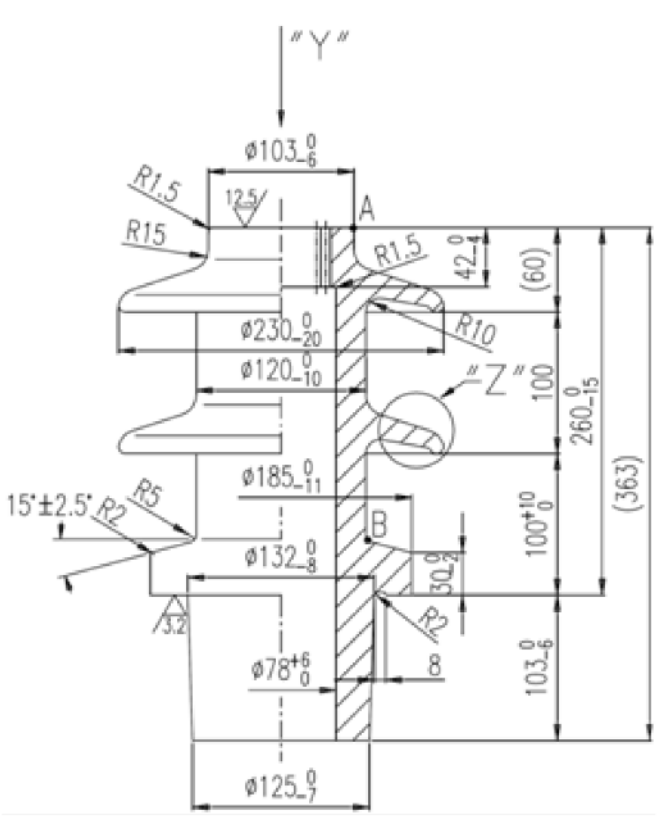


Figure A.14 — Insulator (Item n°1), type 25
Calculated nominal distance AB of represented insulator 385 mm

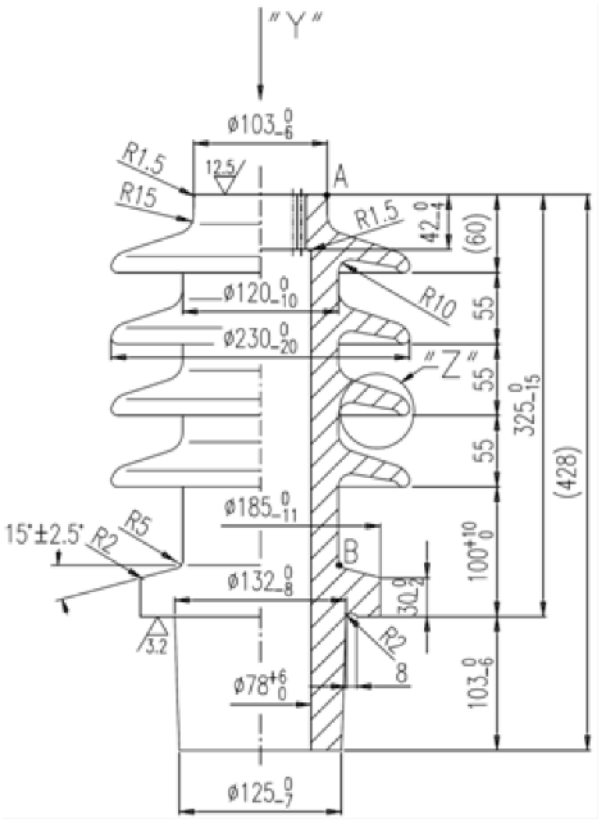
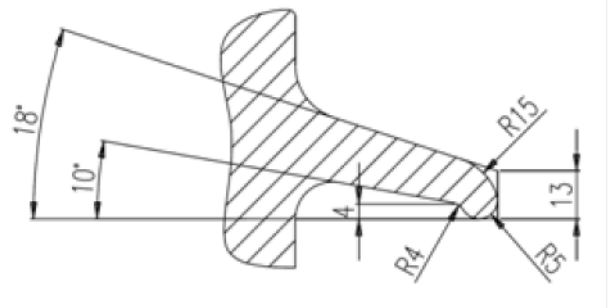
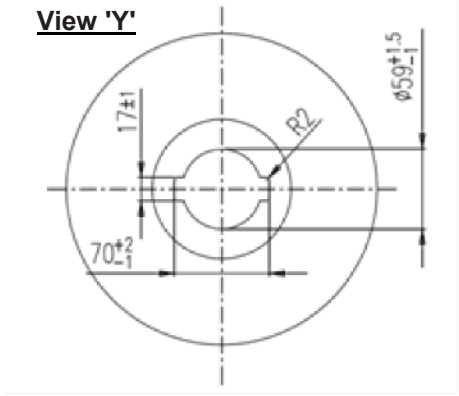


Figure A.15 — Insulator (Item n°1), type 26
Calculated nominal creepage distance AB of represented 620 mm

Detail 'Z'



View 'Y'



Material: Porcelain complying with C 100 series of EN 60672-3 or equivalent material
Color: Brown (other colors are allowed by special agreement)
Surface: Glazed except machined surfaces, ground surface and surfaces marked by -·-·-·-·- (other kind of surface for inner hole and lower extremity by special agreement).

All dimensions in mm.
Unless otherwise stated in the drawing tolerances according to EN 62155

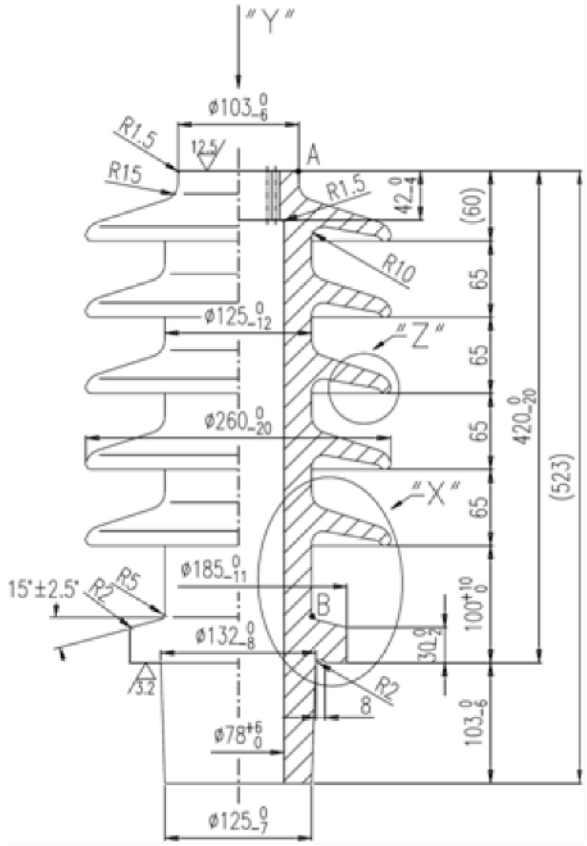


Figure A.16 — Insulator (Item n°1), type 27&27M

Calculated nominal distance AB of represented insulator 920 mm

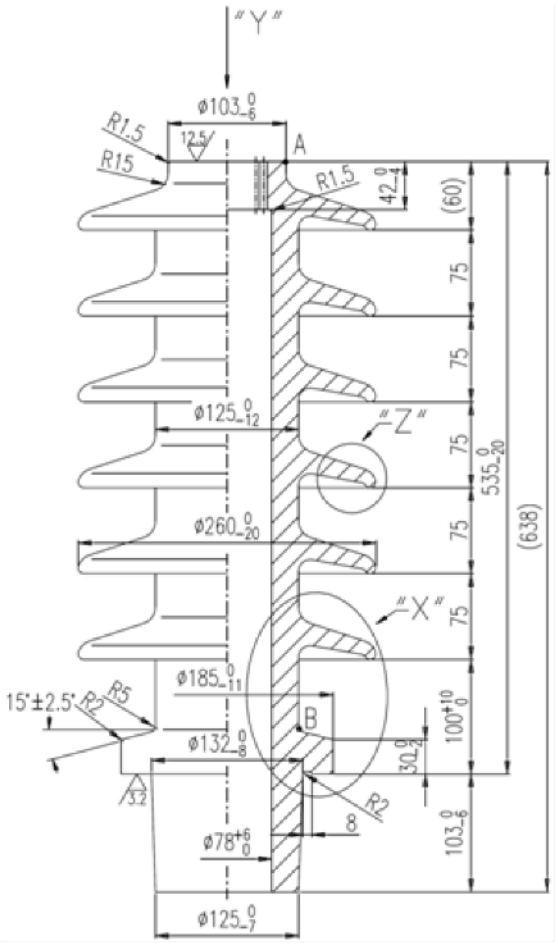
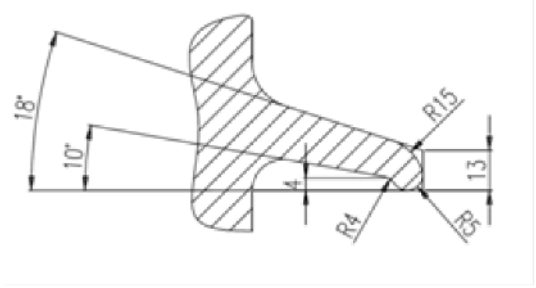


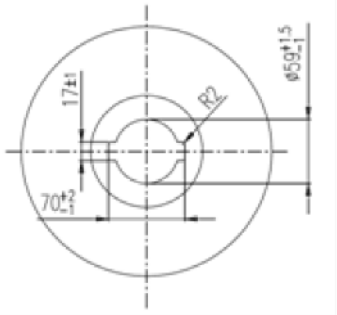
Figure A.17 — Insulator (Item n°1), type 28 & 28M

Calculated nominal creepage distance AB of represented 1135 mm

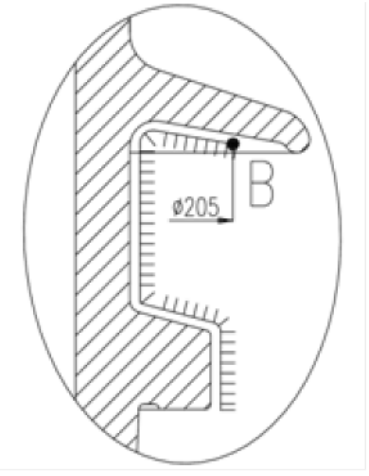
Detail 'Z'



View 'Y'



Detail 'X'
Only on models 27M and 28M



NOTE The same porcelain with metallization are named type 27M and 28M.
Calculated nominal creepage distances: for 27M is 830 mm and for 28M is 1 045 mm.

A.5 52 kV / 250 - 3150 A insulators

Material: Porcelain complying with C 100 series of EN 60672-3 or equivalent material
Color: Brown (other colors are allowed by special agreement)
Surface: Glazed except machined surfaces, ground surface and surfaces marked by - - - - - - (other kind of surface for inner hole and lower extremity by special agreement).

All dimensions in mm.
Unless otherwise stated in the drawing tolerances according to EN 62155
Surface marked with |_|_|_|_|_| are metalized (or equivalent).
Calculated nominal creepage distance of corrugated form in oil is 185 mm.

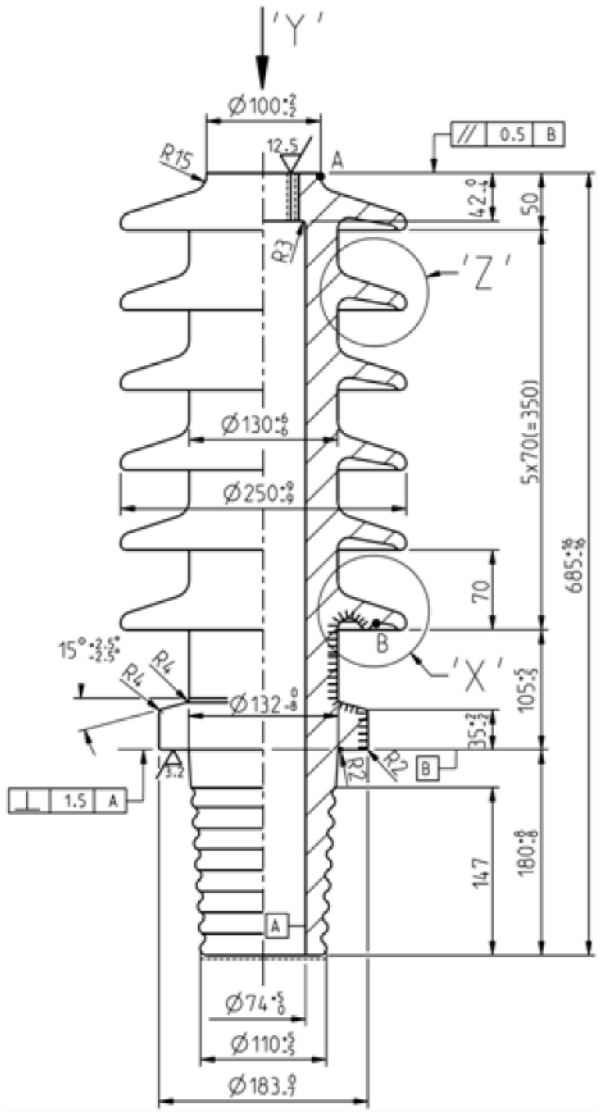
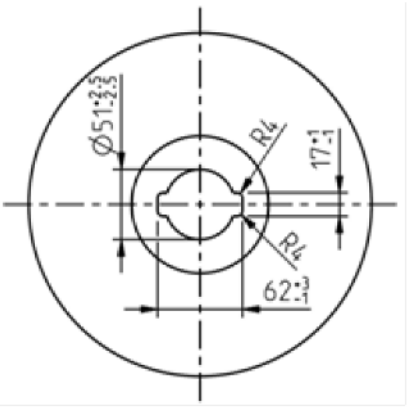


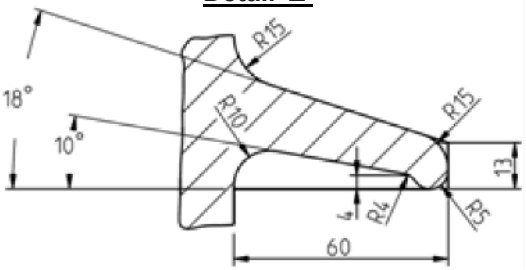
Figure A.18 — Insulator (Item n°1), type 29

Calculated nominal creepage distance AB of represented insulator 950 mm

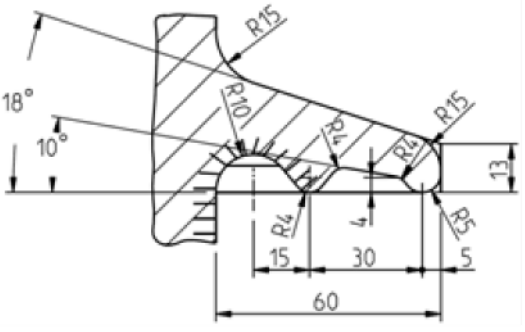
View 'Y'



Detail 'Z'



Detail 'X'



Material: Porcelain complying with C 100 series of EN 60672-3 or equivalent material
Color: Brown (other colors are allowed by special agreement)
Surface: Glazed except machined surfaces, ground surface and surfaces marked by -·-·-·-·- (other kind of surface for inner hole and lower extremity by special agreement).

All dimensions in mm.
Unless otherwise stated in the drawing tolerances according to EN 62155
Surface marked with |_|_|_|_| are metallized.
Calculated nominal creepage distance of corrugated form in oil is 185 mm.

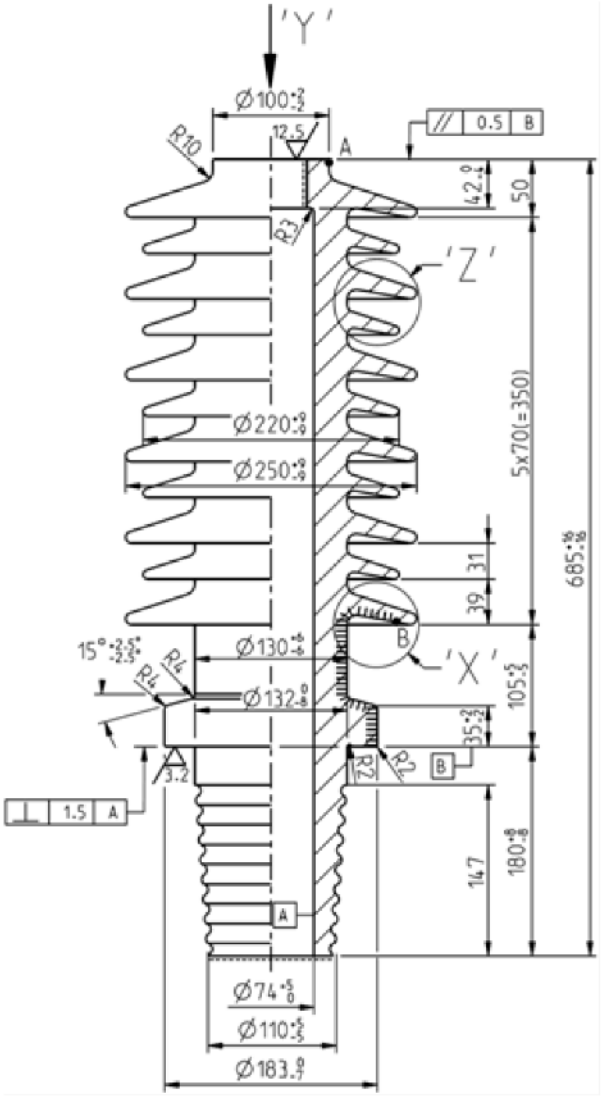


Figure A.19 — Insulator (Item n°1), type 30
Calculated nominal creepage distance AB of represented insulator 1350 mm

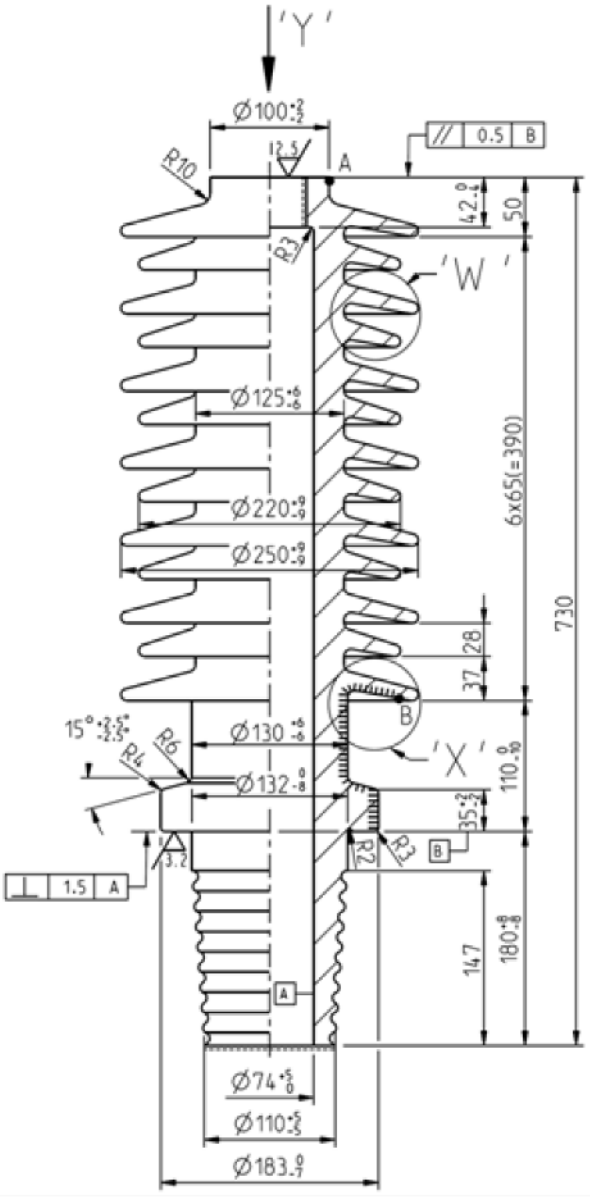
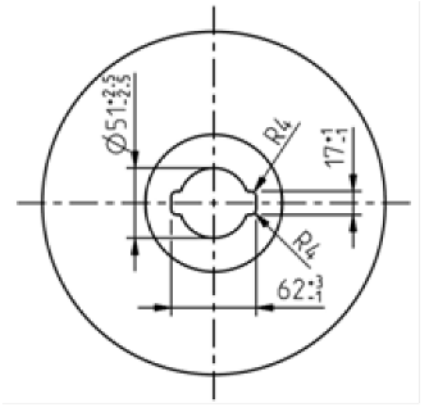
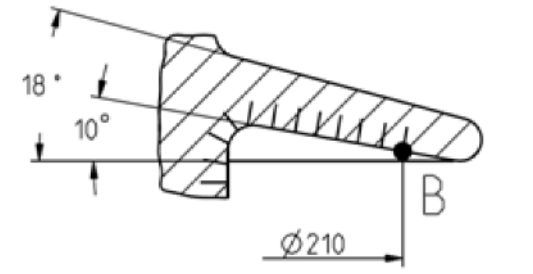


Figure A.20 — Insulator (Item n°1), type 31
Calculated nominal creepage distance AB of 1655 mm

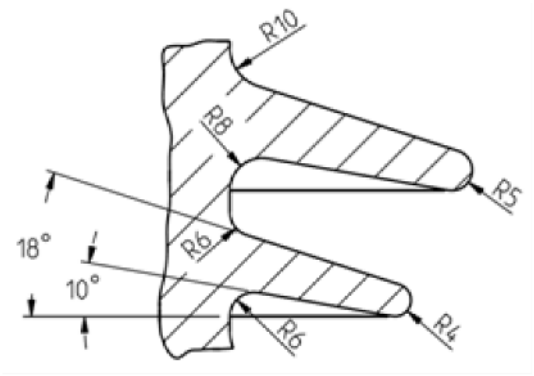
View 'Y'



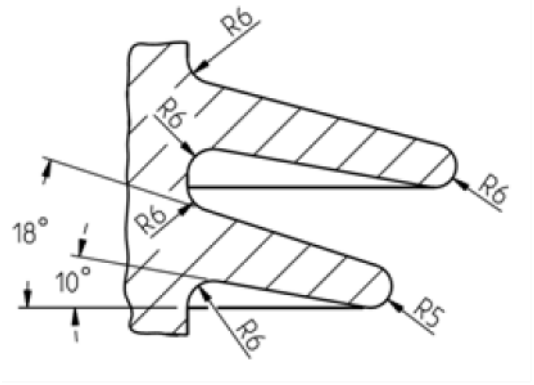
Detail 'X'



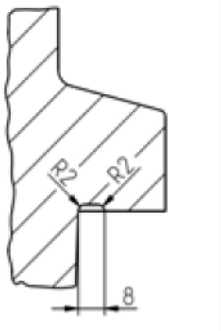
Detail 'Z'



Detail 'W'



Detail for socket porcelain of types 21,22,23,24,25,26,27,28



A.6 Adjusting ring for porcelains - Type 52 kV

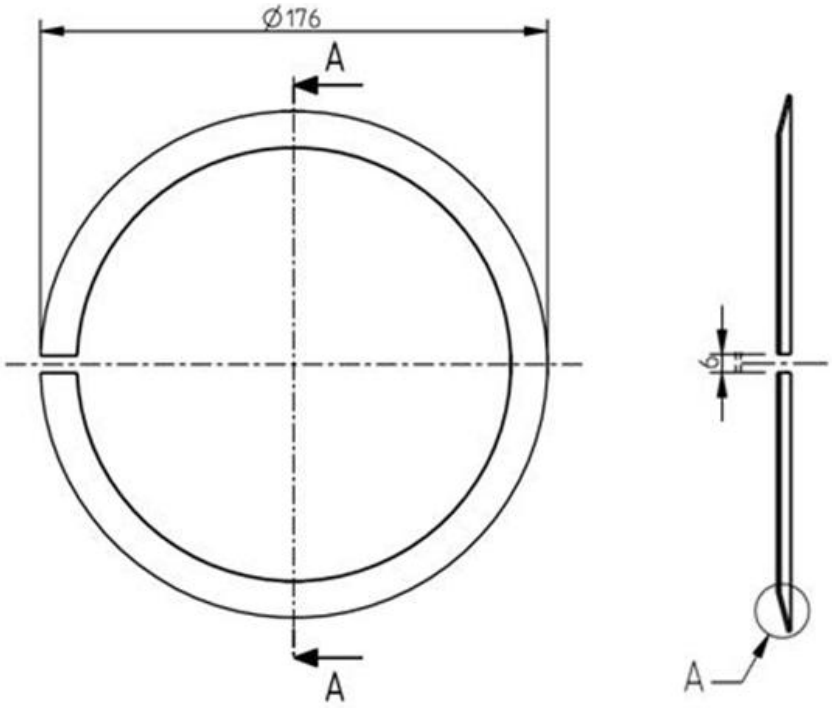
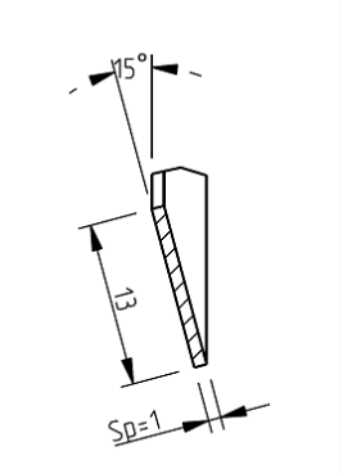


Figure A.21 — Adjusting ring

Detail 'A'



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IEC Guide 109, *Environmental aspects — Inclusion in electrotechnical product standards*

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