

English version

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

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

Durchführungen über 1 kV bis 52 kV
und von 250 A bis 3,15 kA
für flüssigkeitsgefüllte Transformatoren

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Management Centre: Avenue Marnix 17, B - 1000 Brussels

Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 36A, Insulated bushings. It was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 50180 on 2010-09-01.

This document supersedes EN 50180:1997.

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

The following dates are proposed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2011-09-01
 - latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2013-09-01
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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 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 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.

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)

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

EN 60137, Bushings for alternating voltages above 1 000 V (IEC 60137)

IEC 60815, Selection and dimensioning of high-voltage insulators intended for use in polluted conditions

IEC Guide 109 and Cenelec TC 111X document¹⁾, Environmental aspects - Inclusion in electrotechnical product standards

NOTE It is highly recommended 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 document by CENELEC TC 111X "Environmental standardization for electrical and electronic products and systems" after finalization can be used as helpful reference.

3 Definitions

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

3.1

open type bushing

a 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

a 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

¹⁾ Under development.

3.3**separable connector**

a 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**

a 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:

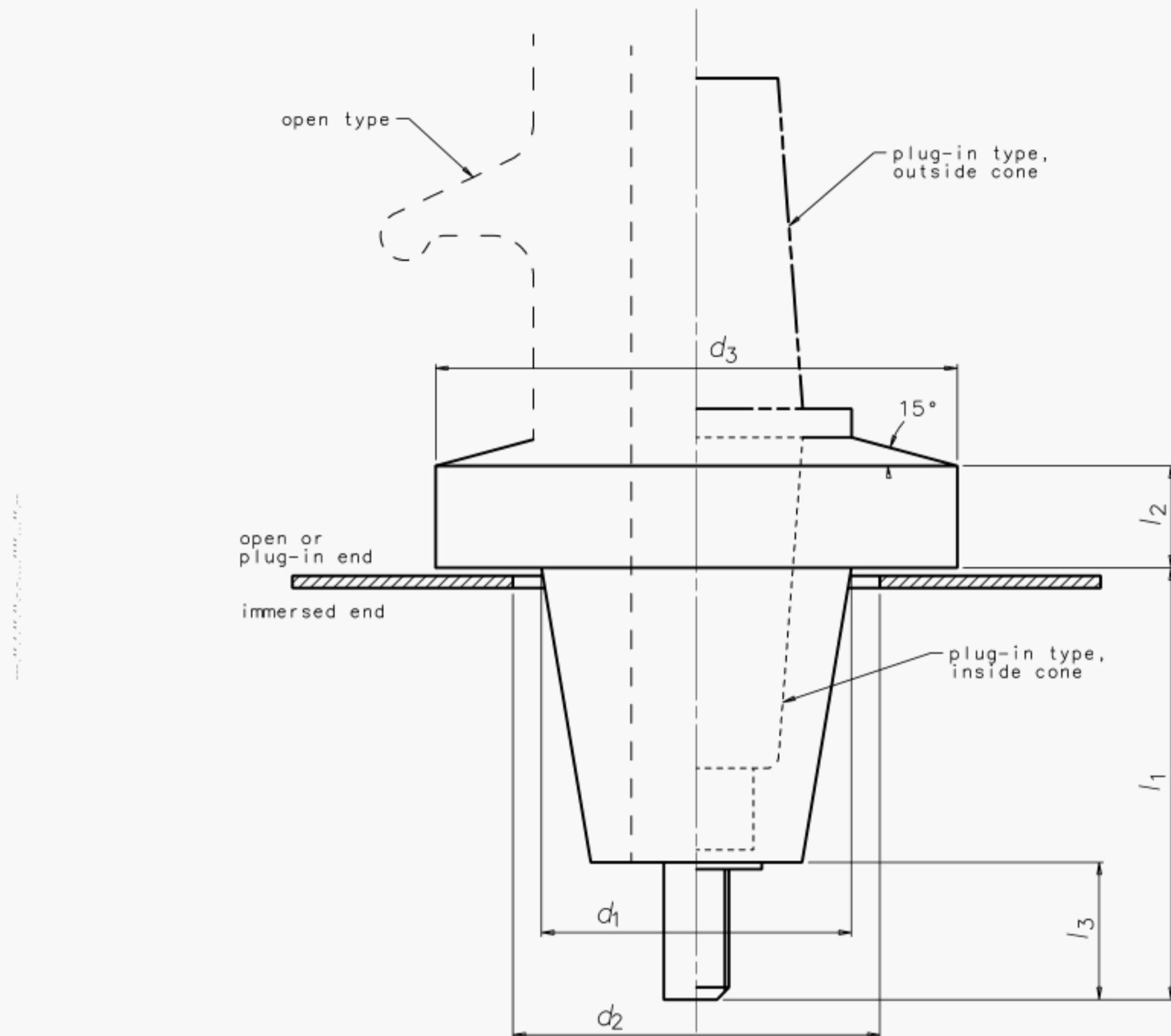
250 - 400 - 630 - 800 - 1250 - 2000 - 3150

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

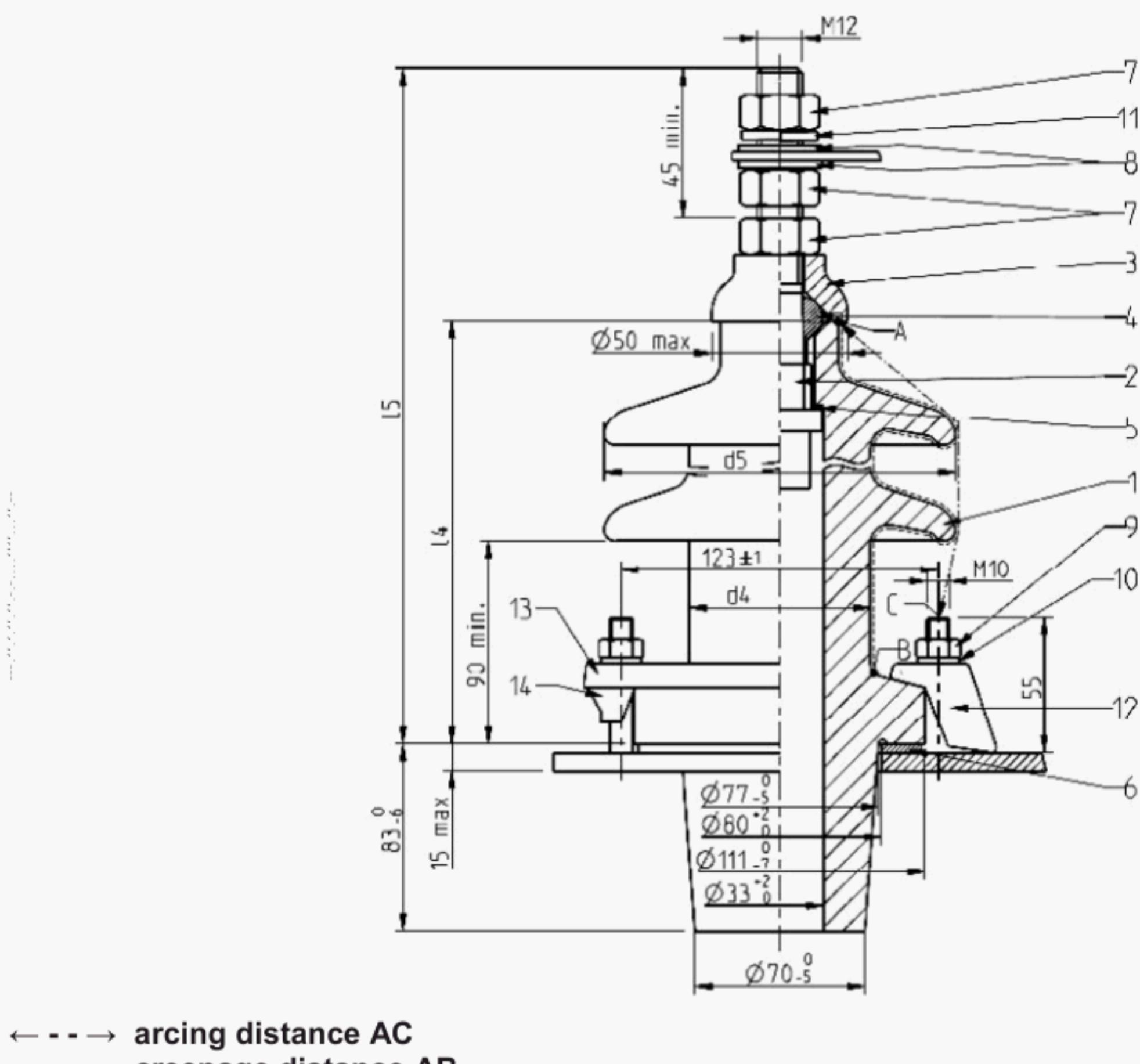


Figure 2 - 250 A types 12 to 36 kV

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

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

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

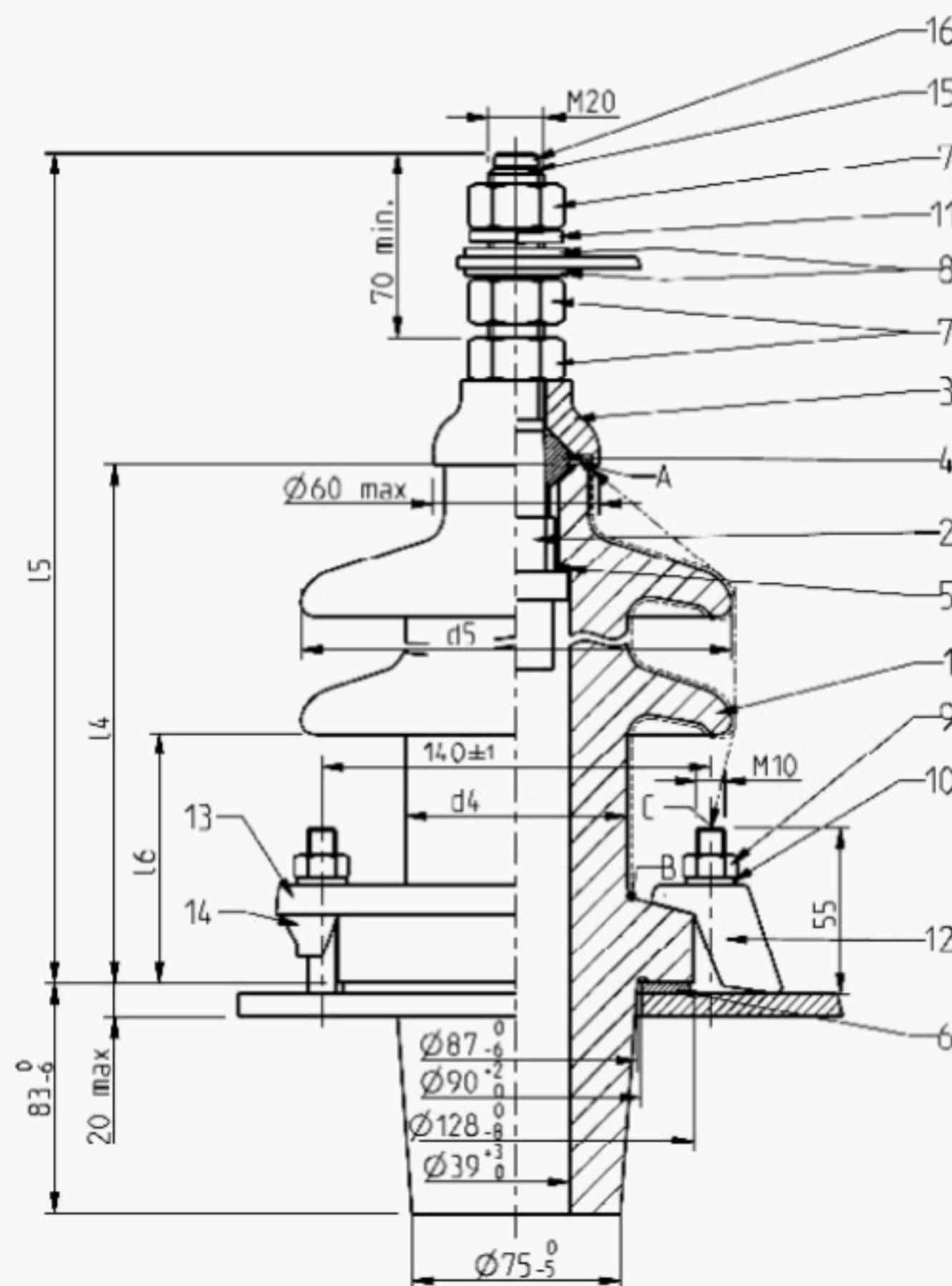
Item	Quantity								Designation	Remarks	
	12-250/P1	12-250/P2	12-250/P4	24-250/P2	24-250/P3	24-250/P4	36-250/P1	36-250/P3	36-250/P4		
1	1	1								Insulator	Porcelain
		1	1								
			1	1							
				1	1						
						1					
2				1						Terminal stud ^a	Brass
3				1						Cap ^a	Brass
4				1						Gasket ^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



← - - → 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)				Insulator 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	
		b	c	d	e								
12-630/P3	12	192	240	300		6	190	235	350	90	80	155	
12-630/P4	12					7	285	325	440	90	85	170	
24-630/P2	24	384	480		372	7	285	325	440	90	85	170	
24-630/P4	24			600	744	8	375	423	540	100	85	180	
36-630/P2	36	576	720			9	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		
1	1					Insulator	Type 6
		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

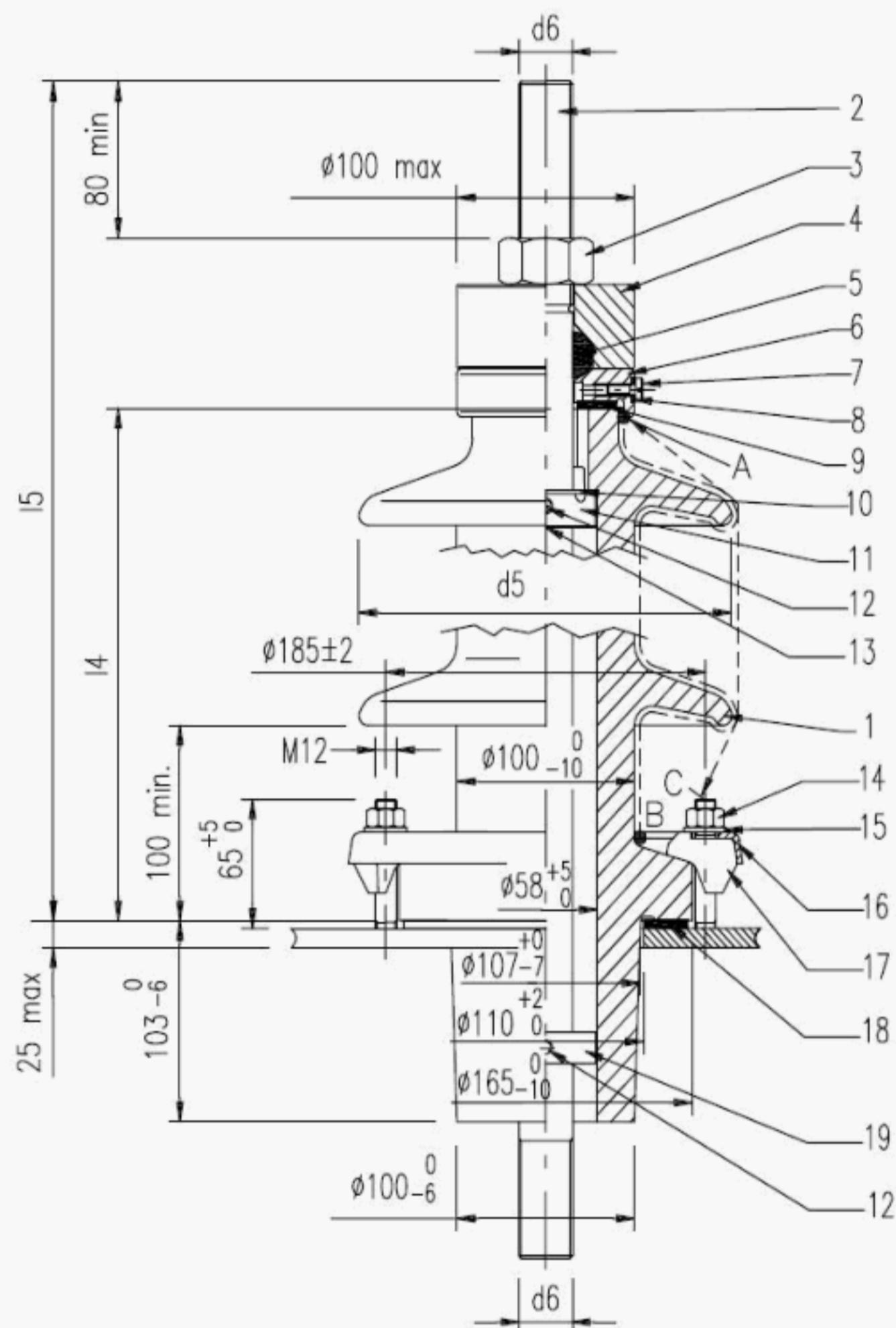
^a Constructional details are not covered by this standard

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



← - - → 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)					Insulator Type	Arcing distance AB mm	l_4 max. mm	l_5 max. mm	d_5 max. mm	d_6 mm
		b	c	d	e							
12-1250/P4	12	192	240	300	372		21	215	260	415	210	
24-1250/P3	24	384	480	600			22	280	325	480	210	
24-1250/P4	24					744	23					
36-1250/P3	36						23					
36-1250/P3M	36	576	720	900			23M	385	420	575	240	M30 x 2
36-1250/P4						1116	24					
36-1250/P4M	36						24M	500	535	690	240	

NOTE Refer to point 4.6 for bushings with metallization or equivalent.

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

Item	12-1250/P4	24-1250/P3	Quantity	24-1250/P4 (M)	36-1250/P3 (M)	36-1250/P4 (M)	Designation	Remarks
1	1						Insulator	Porcelain
		1						
			1	1				
					1			
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

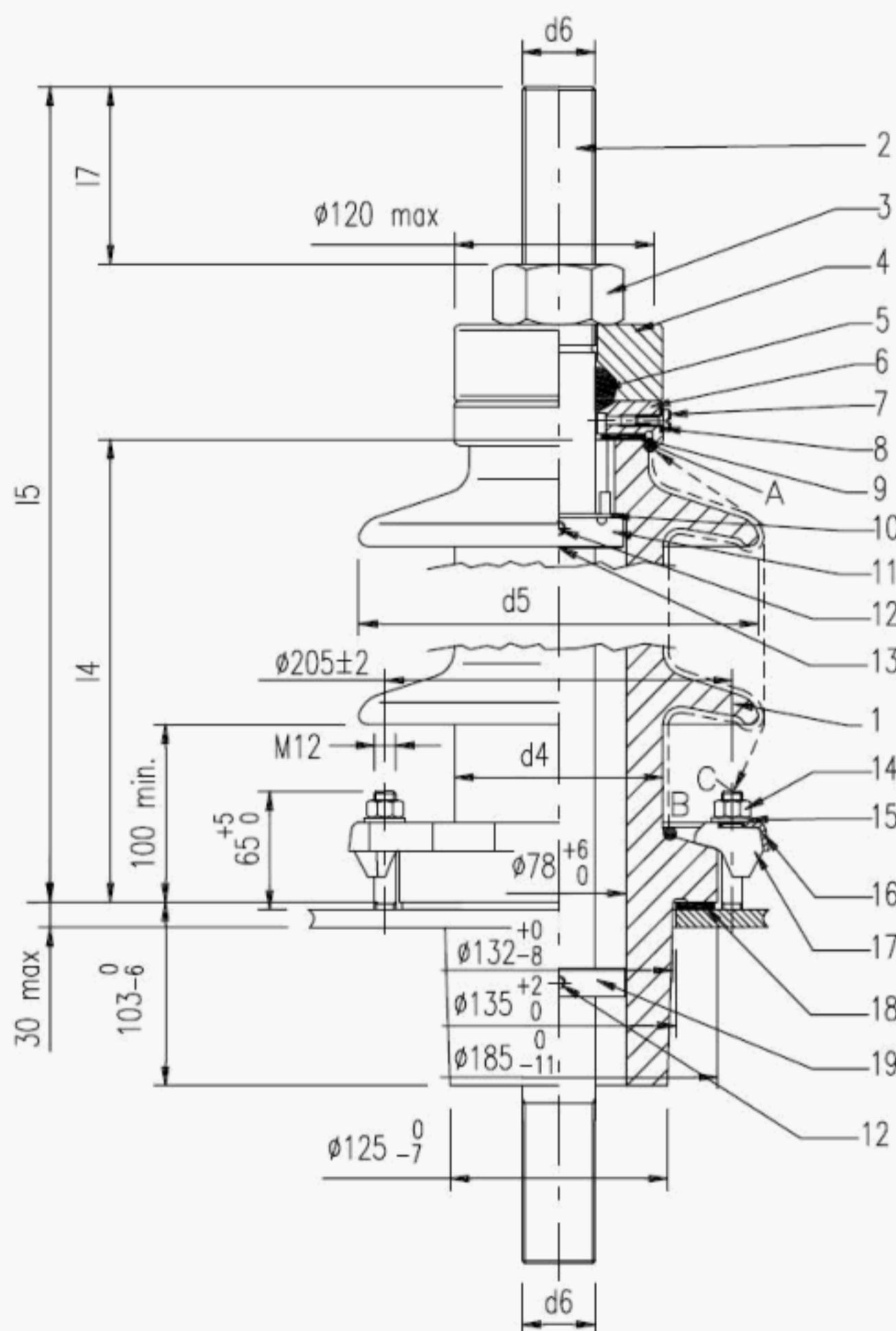
^b If brass is used the rated current I_r shall be reduced subject to an agreement.

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



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

NOTE Refer to point 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	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)	Quantity	Designation	Remarks
1	1						Insulator	Type 25
		1						Type 26
			1	1				Type 27()
					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

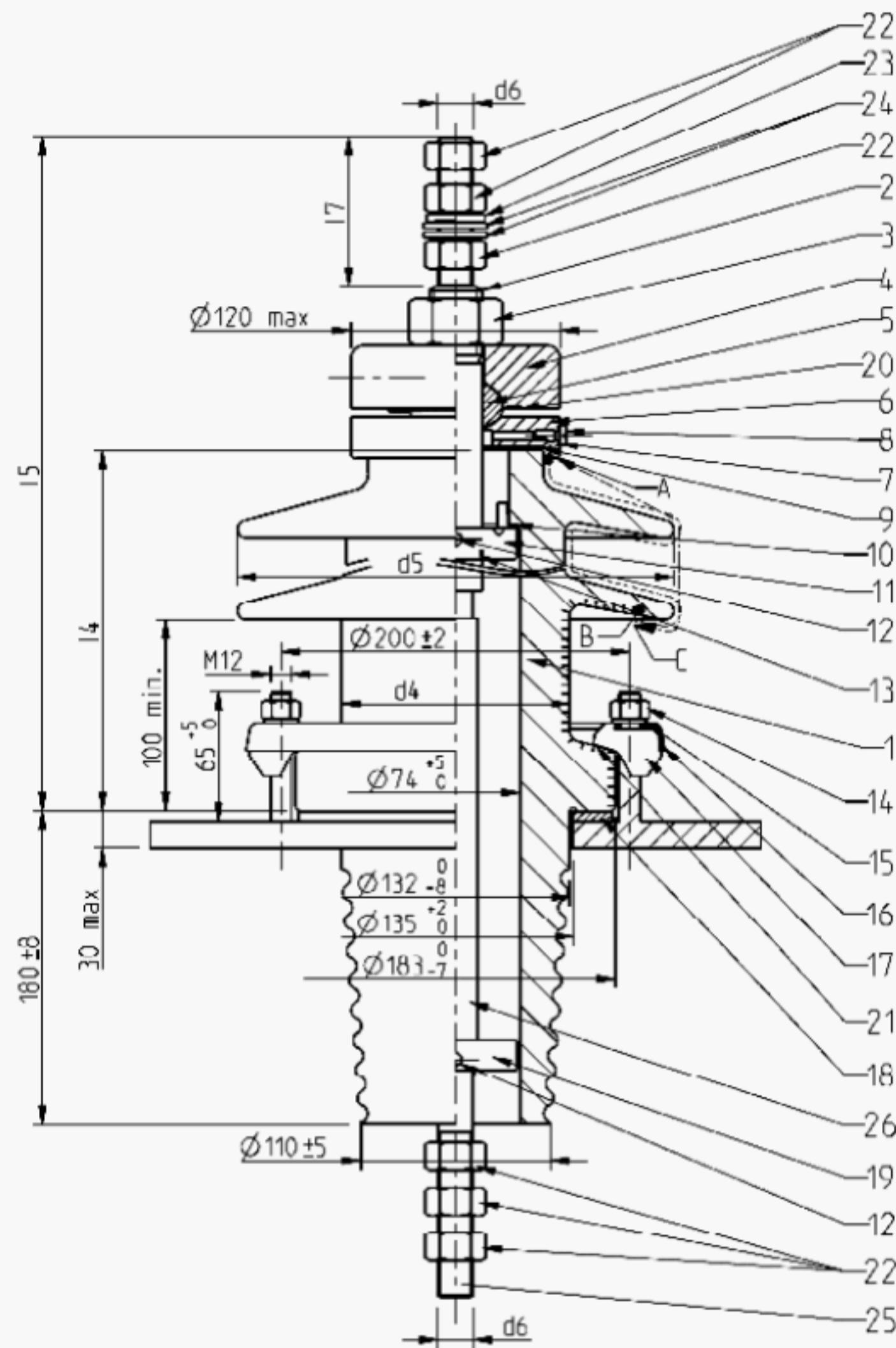
^b If brass is used the rated current I_r shall be reduced subject to an agreement.

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



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			Insulator type	Arcing Distance AC mm	I_4 max. mm	I_5 max. mm	I_7 max. mm	d_4 max. mm	d_5 max. mm	d_6 mm
		b	c	d								
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	31	520	550	705	60	136	259	M12
				1 612				730	85			M20

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

Item	52-250/P1 52-630/P1	Quantity	52-250/P3 52-630/P3	52-250/P4 52-630/P4	Designation	Remarks	
1	1				Insulator	Type 29	
	1					Type 30	
	1		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		

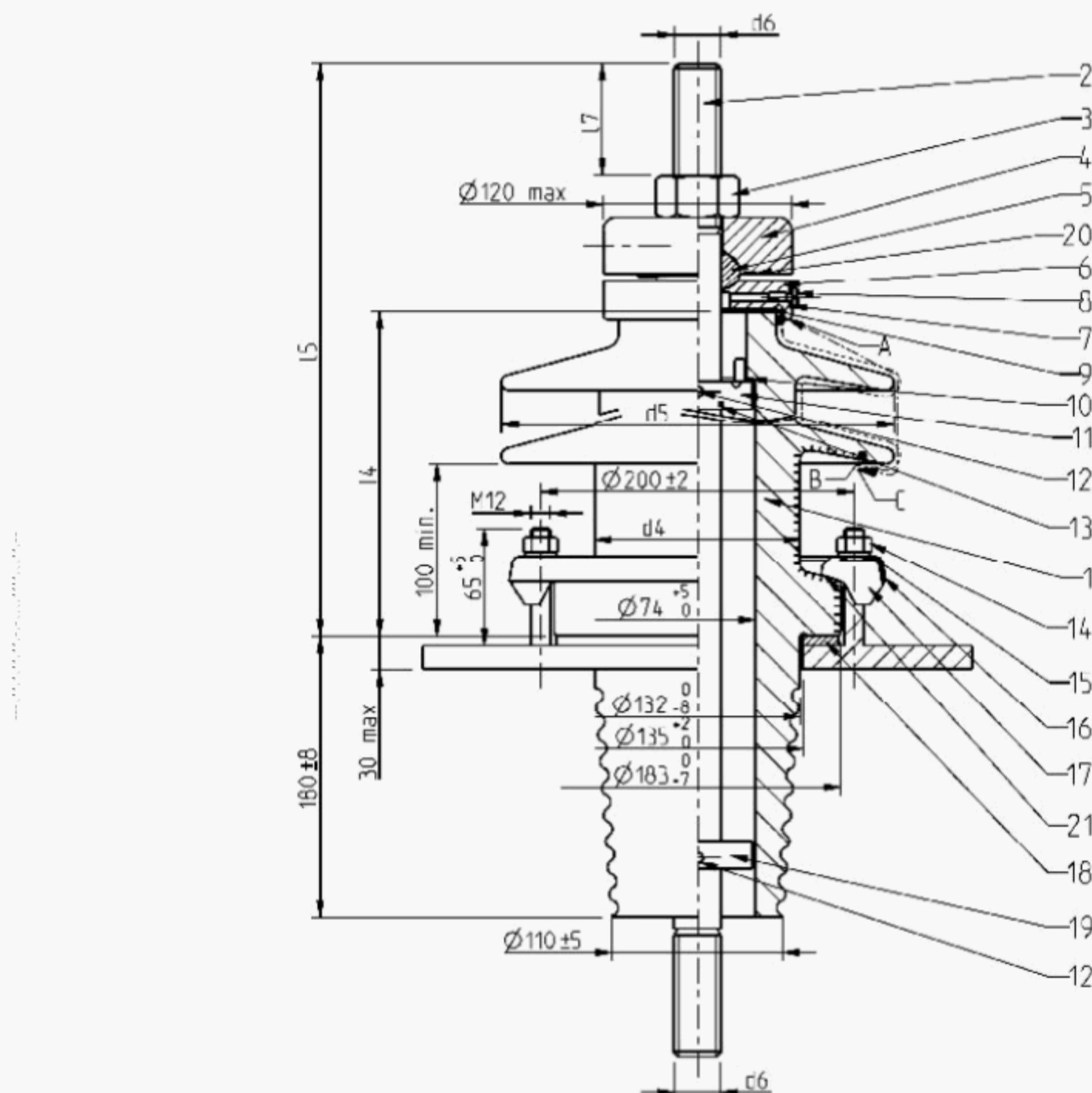
^a Constructional details are not covered by this standard^b If brass is used the rated current I_r shall be reduced subject to an agreement.^c See constructional details as in Figure A.21.

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)					Insulator 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
		b	c	d	e									
52-1250/P1	52	832				29	480	505	655	65	136	259	M30x2	
52-2000/P1									685	85			M42x3	
52-3150/P1									690					
52-1250/P3	52	832	1 040	1 300		30	480	505	655	65	136	259	M30x2	
52-2000/P3									685	85			M42x3	
52-3150/P3									690					
52-1250/P4	52	832	1 040	1 300	1 612	31	520	550	700	65	136	259	M30x2	
52-2000/P4									730	85			M42x3	
52-3150/P4									735					

Table 13 - List of components 1 250 A – 2 000 A – 3 150 A types 52 kV

Item	Quantity	Designation	Remarks			
	52-1250/P1 52-2000/P1 52-3150/P1	52-1250/P3 52-2000/P3 52-3150/P3	52-1250/P4 52-2000/P4 52-3150/P4	Insulator	Type 29	Porcelain
1	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.

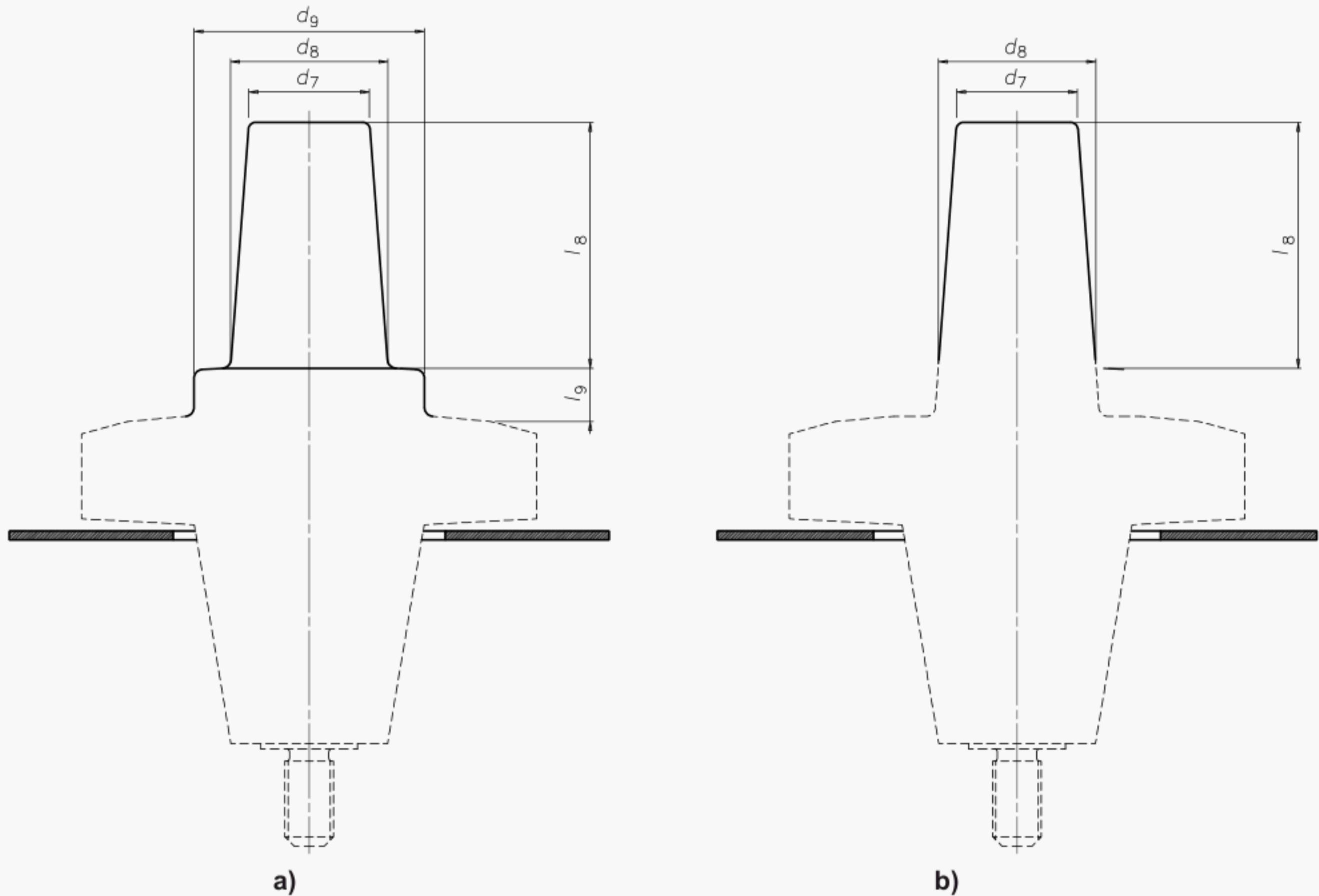


Figure 8 - Outside cone plug-in type bushings

Table 14 - Interface dimensions

U_m kV	I_r A	d_7 mm	$d_8 \pm 0,2$ mm	$d_9 \pm 0,2$ mm	I_8 mm	I_9 min. mm	Contact type	Interface type	Fig.
12-24	250	+ 0,1 31 - 0,3	32,5	48,5	0 48 - 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

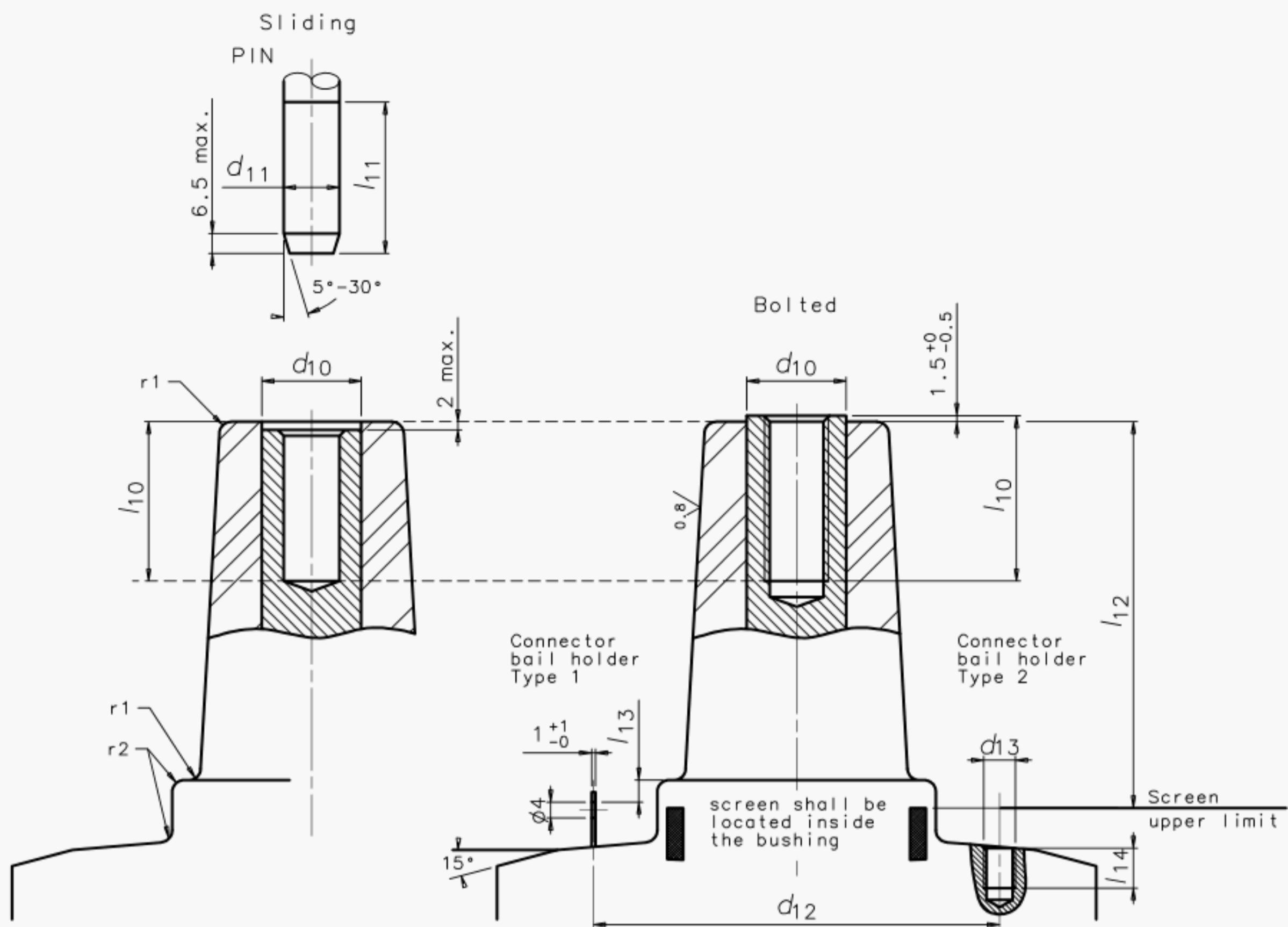
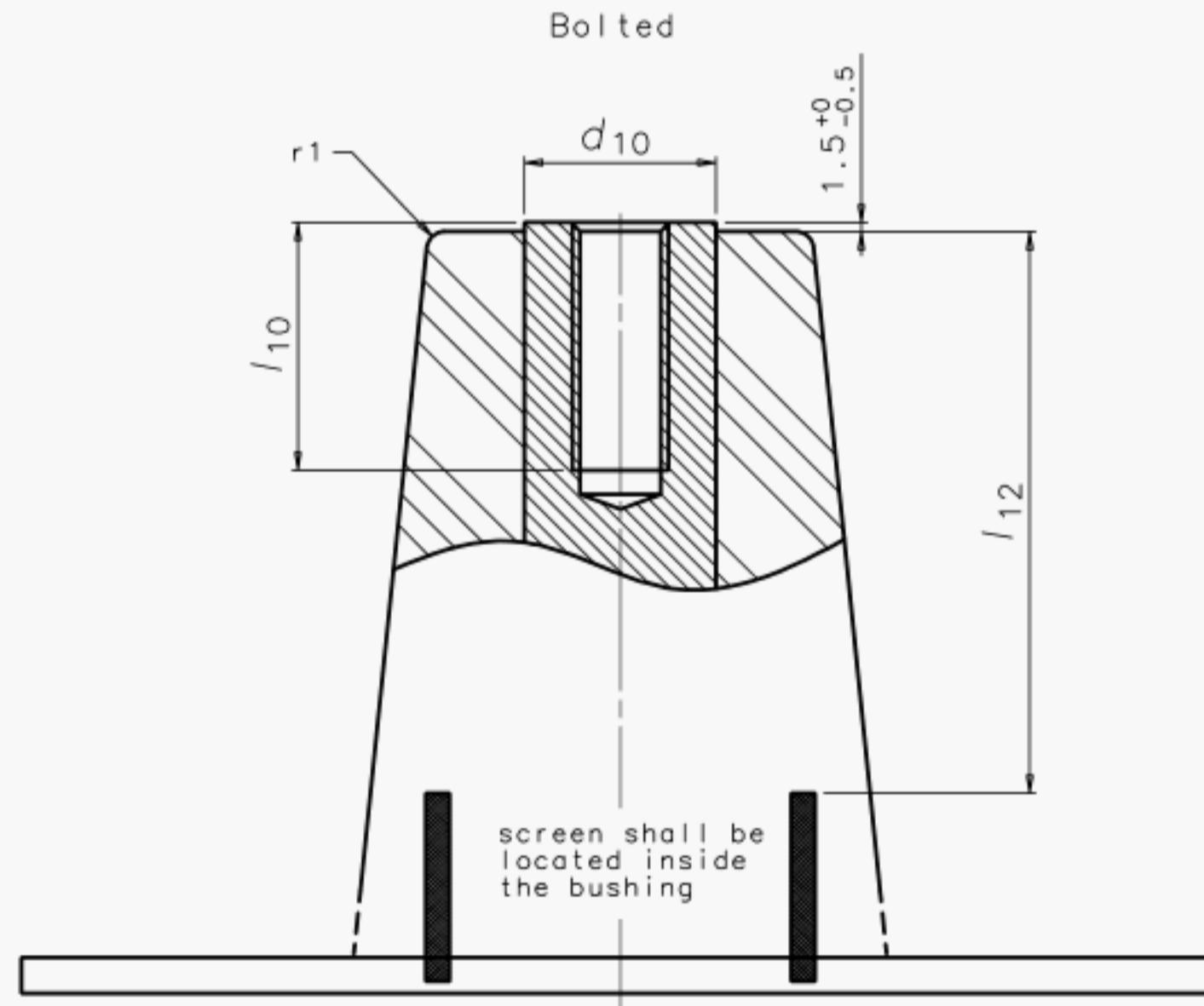
Interface type: F

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

Table 15 - Bushing dimensions

U_m kV	I_r A	Bushing contact						I_{11}	I_{12}	Radius		Bail holder Type 1 or 2			I_{13} ± 2	I_{14}	Interface and bushing type
		Type	Material ^a	d_{10} nominal	d_{11}	Thread	I_{10}			min.	max.	r_1	r_2	Location d_{12} $\pm 0,5$	Required number	d_{13} Type 2	
mm	mm	mm	mm	mm	mm	mm	mm	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																E1	
12-24	1 250	Bolted	Cu	32	-	M 16	29	88	3	3	b 123	b 2	b M8	-	10	D2	
36																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 must 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 for inside cone Plug-in type bushings are specified in Figure 10 and 11 and in Tables 16 and 17.

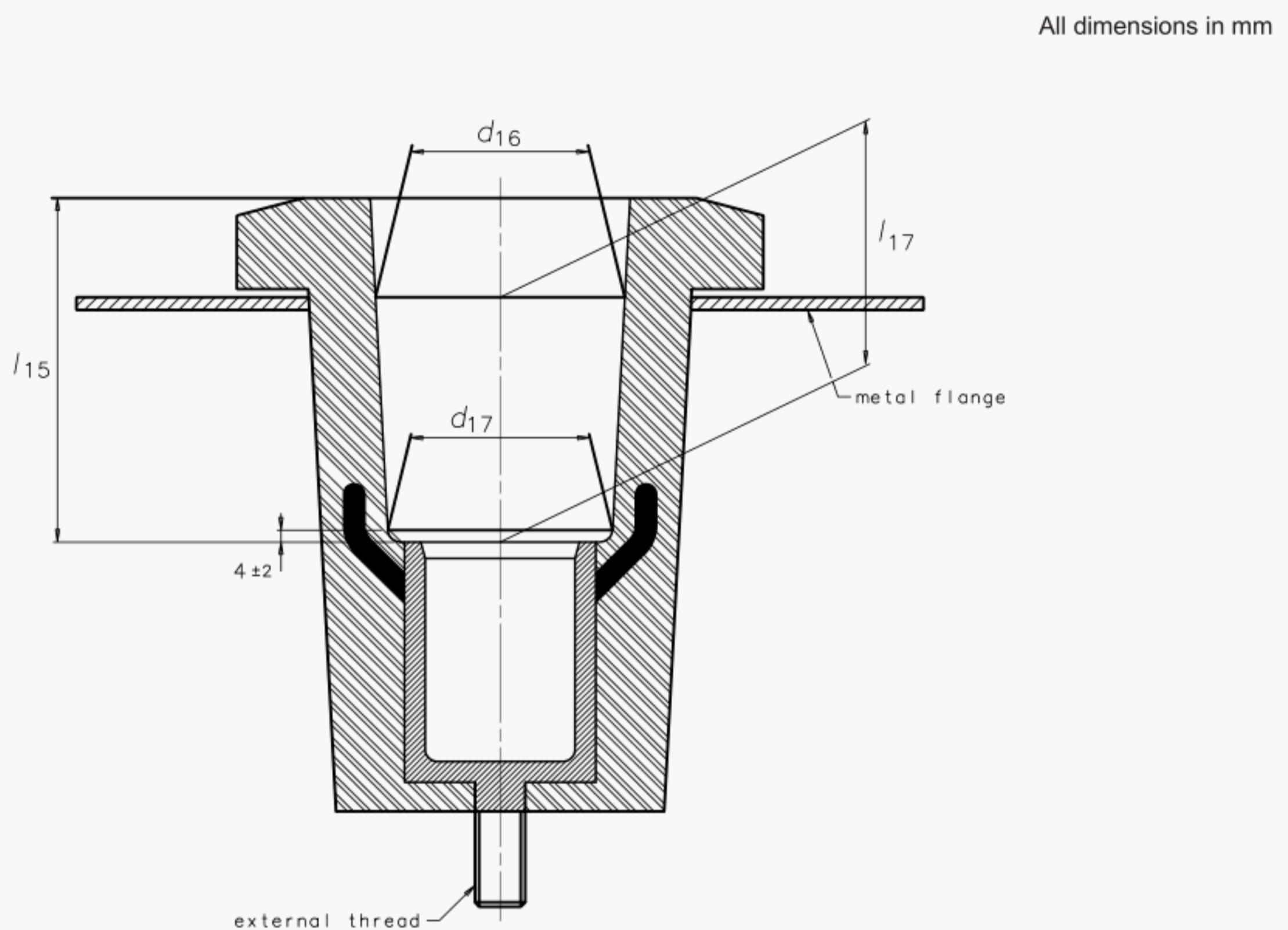
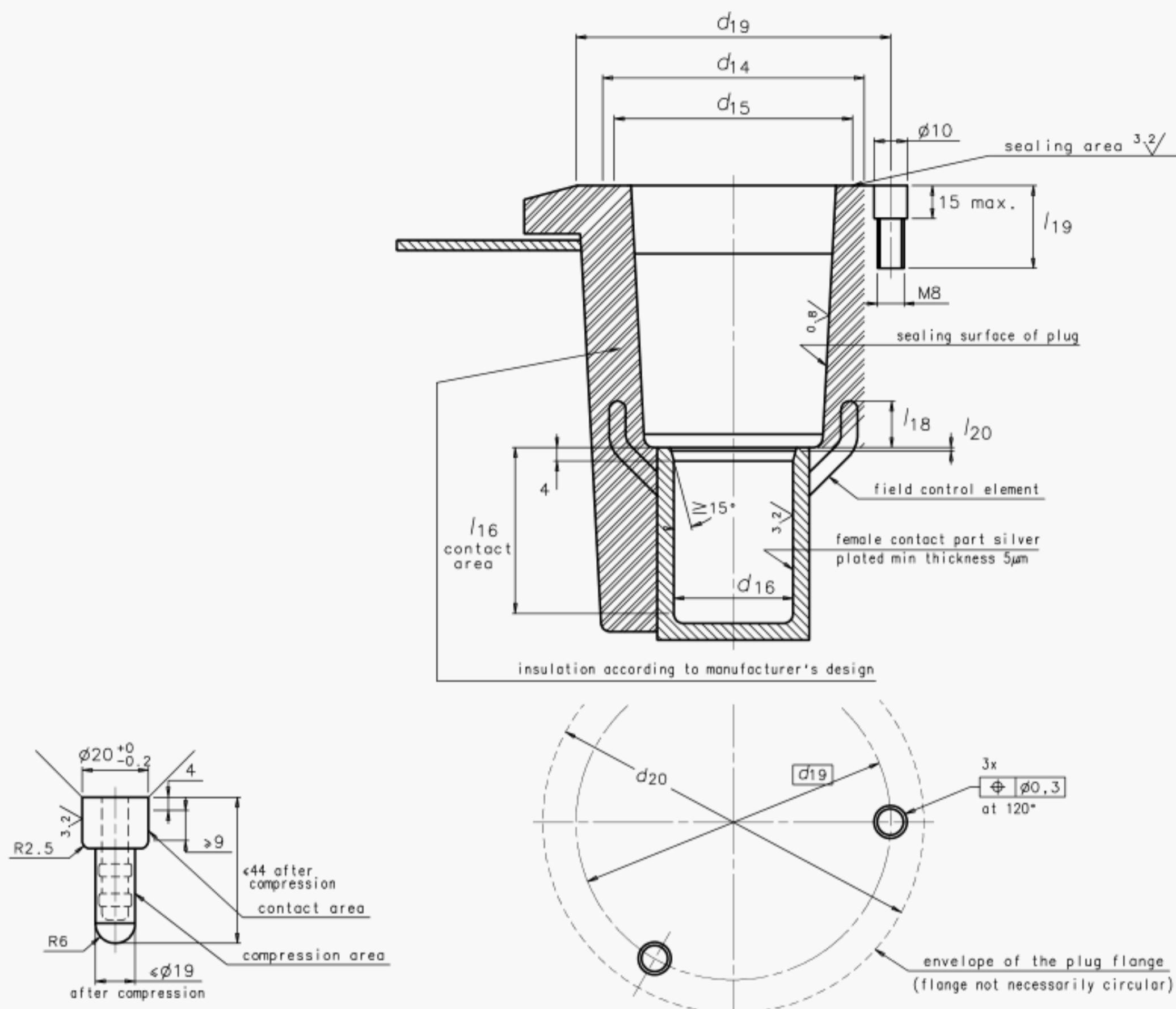


Figure 10 - Inside cone plug-in type bushings

Table 16 - Interface dimensions

U_m kV	I_r A	d_{16} $\pm 0,4$ mm	d_{17} $\pm 0,4$ mm	l_{15} $\pm 1,3$ mm	l_{17} $\pm 0,2$ mm	Interface type
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



DIMENSION OF PLUG CONTACT PIN FOR $I_r = 250A$

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

Table 17 - Interface dimensions

U_m kV	I_r A	d_{14} mm	d_{15} mm	d_{16} $+ 0,1$ 0	d_{19} mm	d_{20} max. mm	l_{16} min. mm	l_{18} $+ 2$ -1	l_{19} $+ 5$ 0	l_{20} mm	Contact type	Interface type
12-24	250	min 69	max 62	^a	88	108	44	14	23	$^{+1}_{-0,5}$	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	115^{+0}_{-18}	95^{+0}_{-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

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).

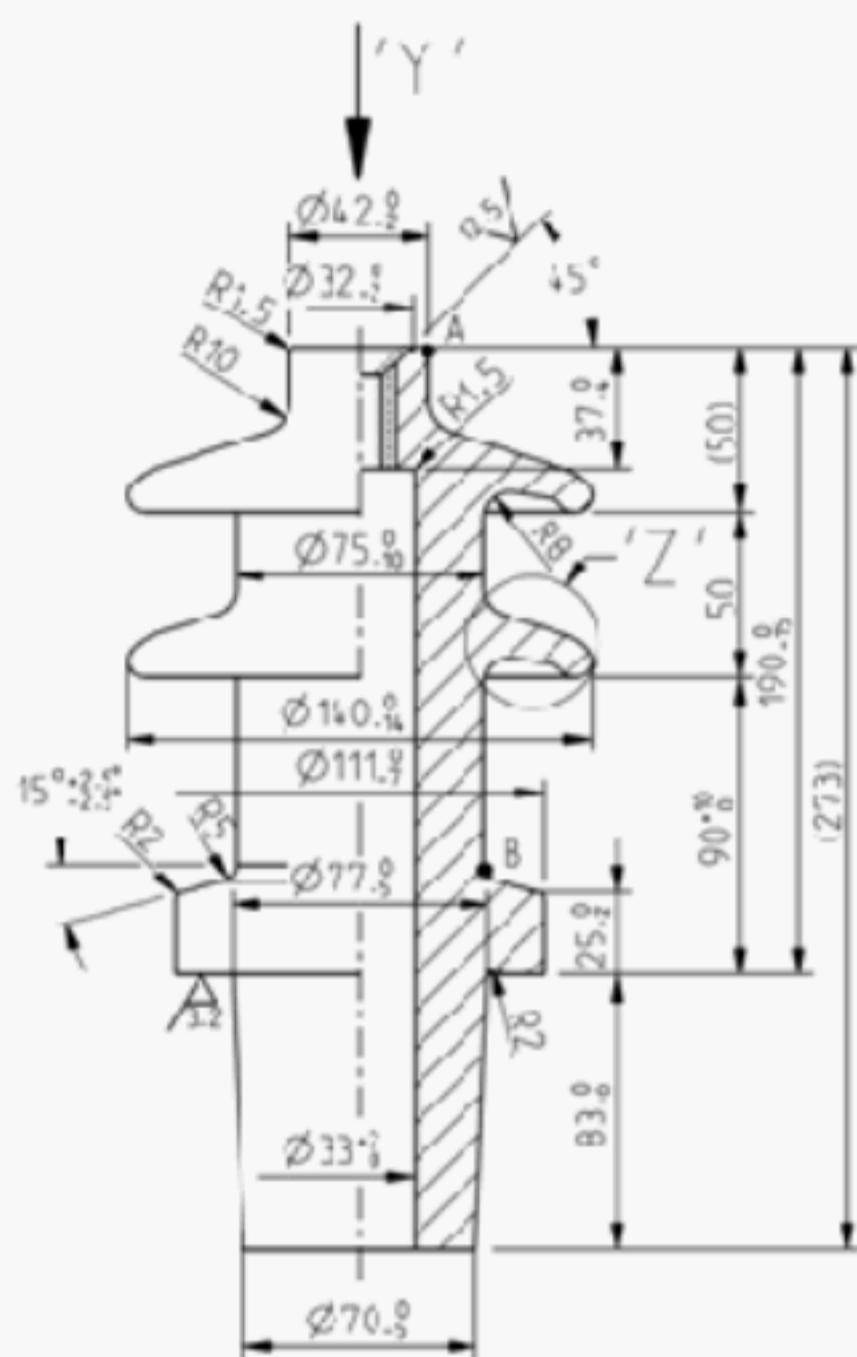


Figure A.1 - Insulator (item N°.1), type 1
 Calculated nominal creepage distance AB of represented insulator
 260 mm

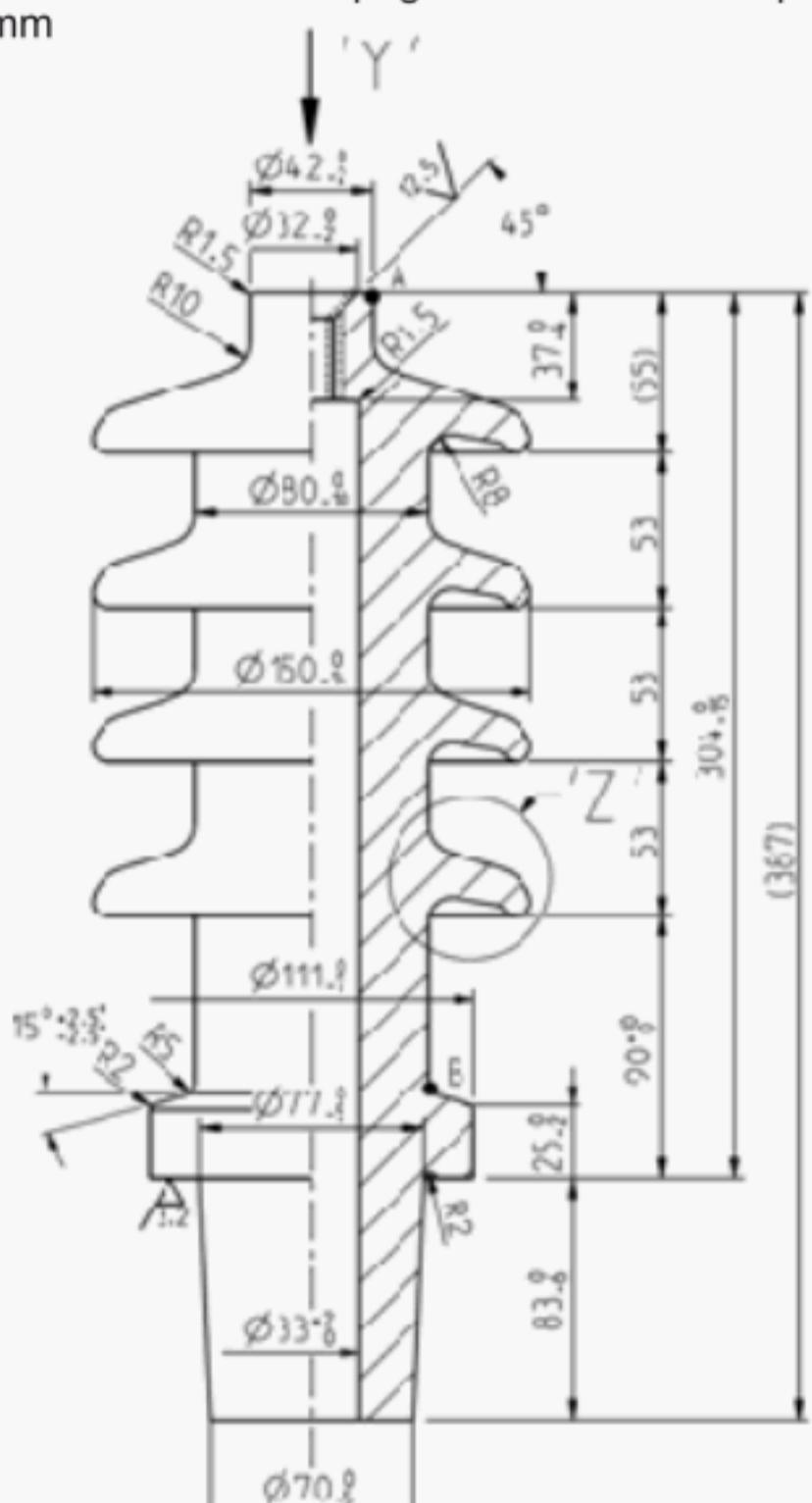


Figure A.2 - Insulator (Item n°1), type 2

Calculated nominal creepage distance AB of represented insulator 490 mm

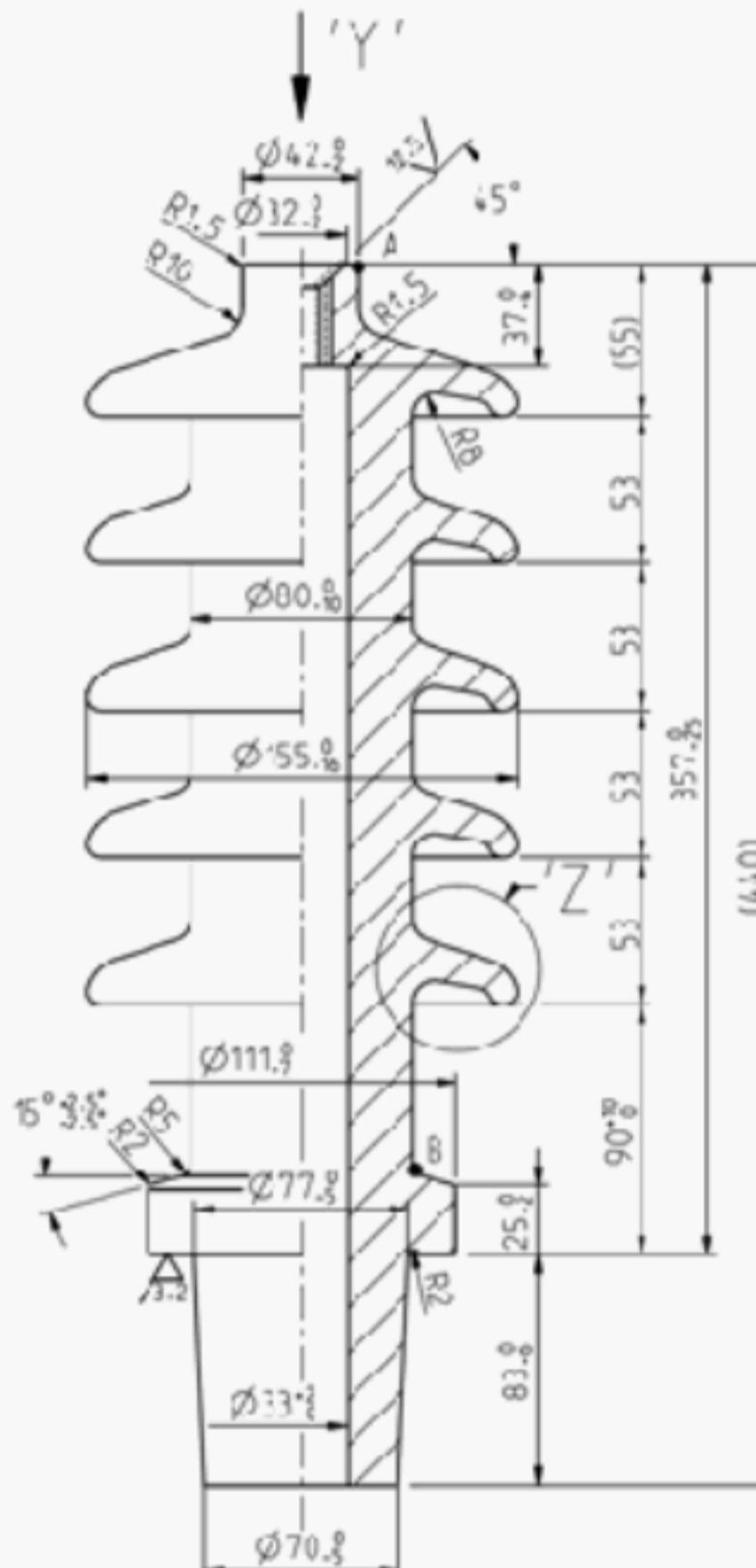


Figure A.3 - Insulator (Item n°1), type 3
 Calculated nominal creepage distance AB of
 represented insulator 605 mm

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

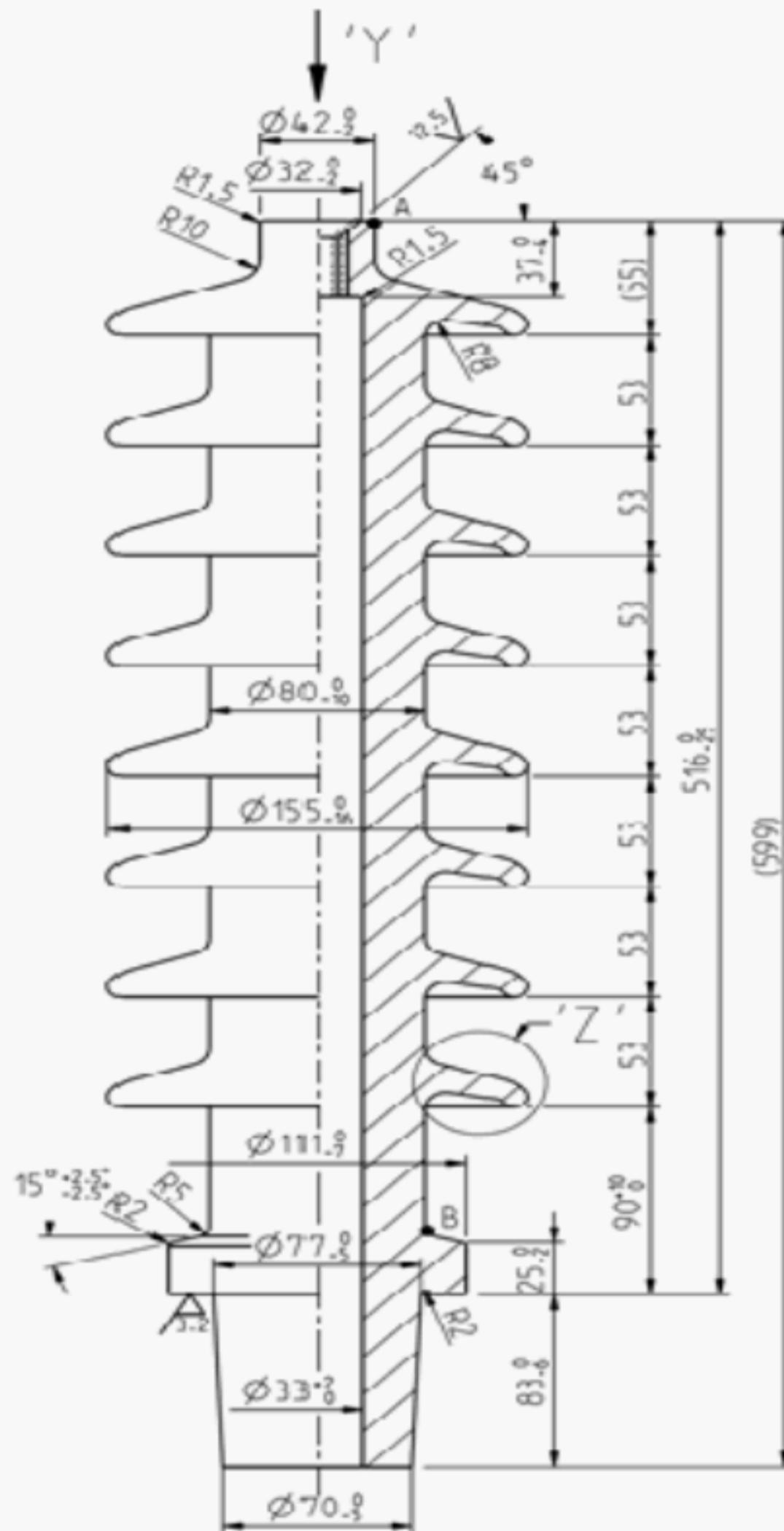


Figure A.4 - Insulator (Item n°1), type 4

Calculated nominal creepage distance AB of represented insulator 935 mm

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

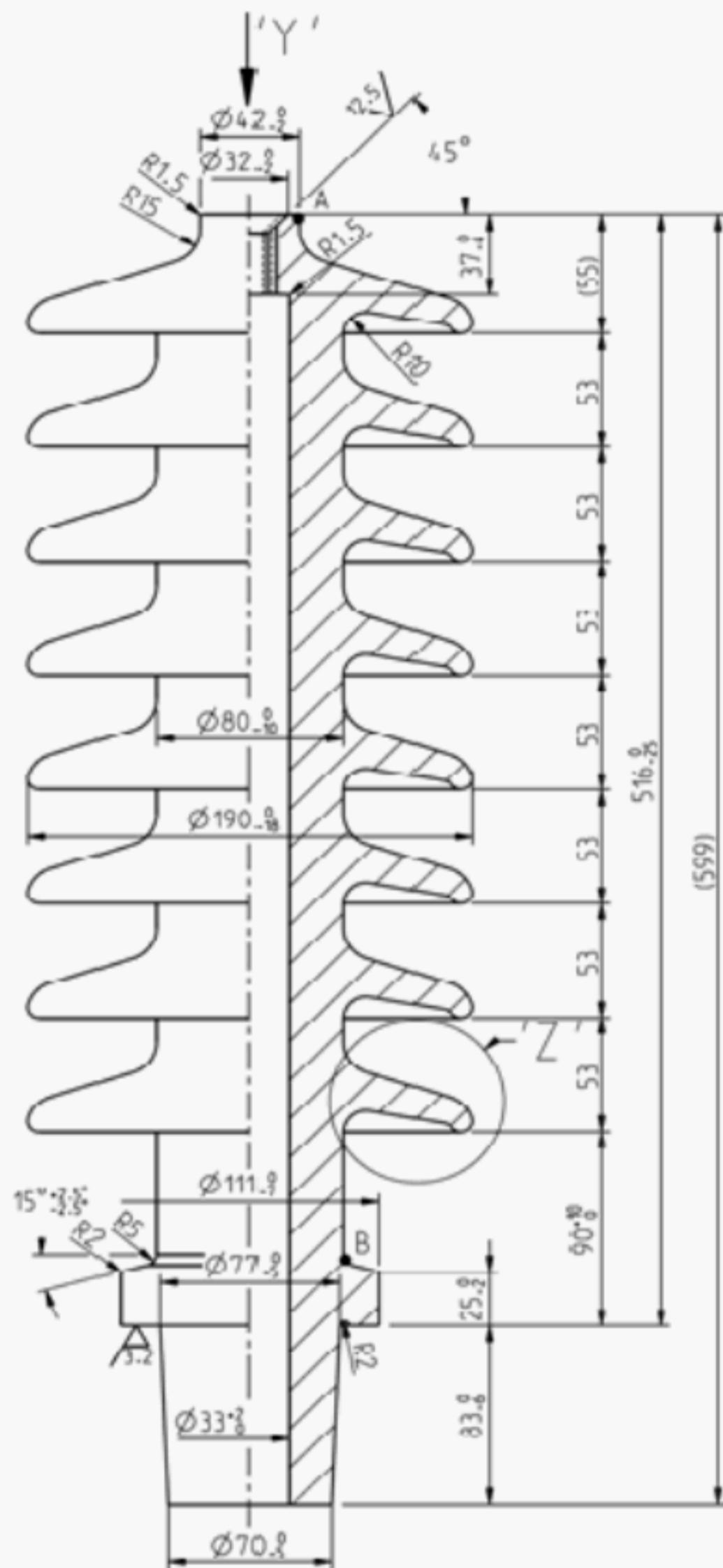
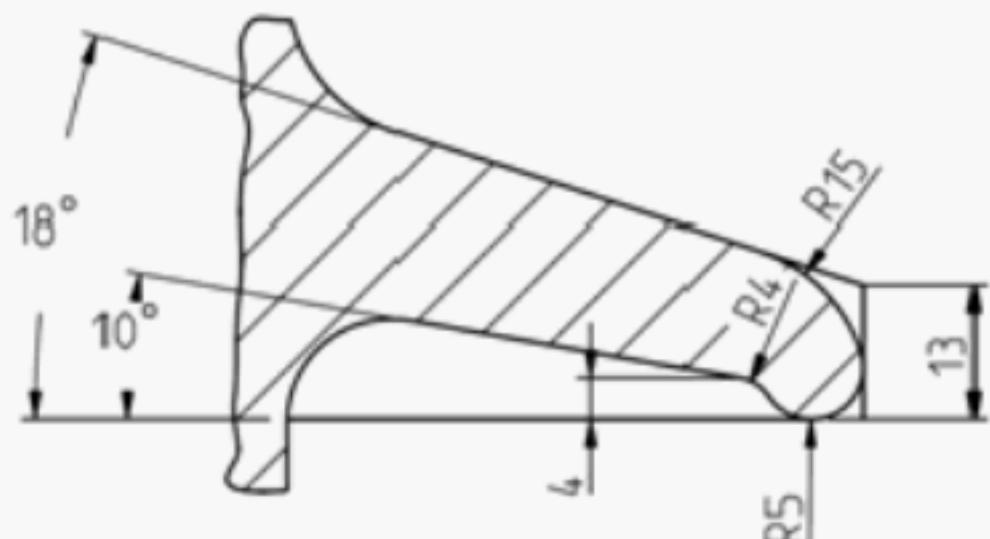


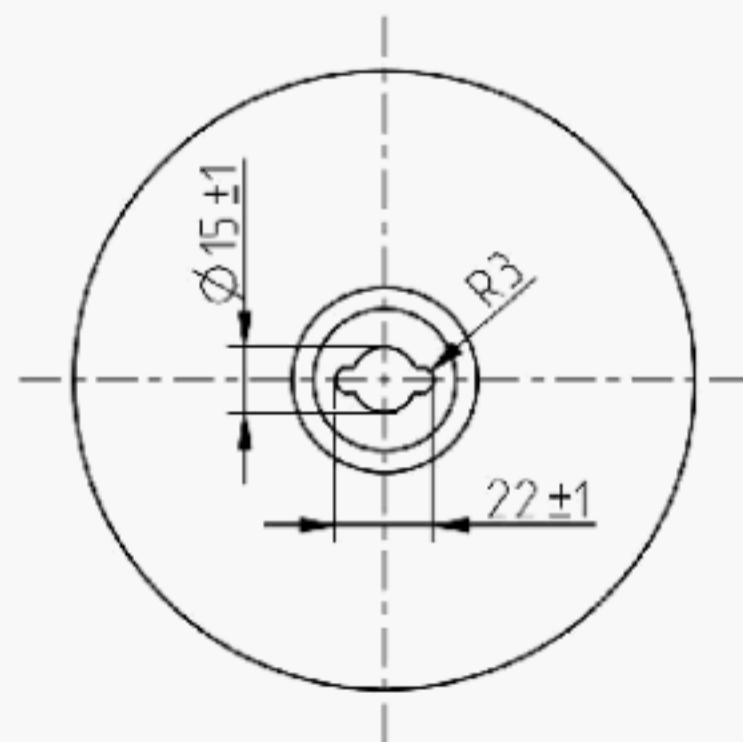
Figure A.5 - Insulator (Item n°1), type 5

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 $\cdots\cdots\cdots$ (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

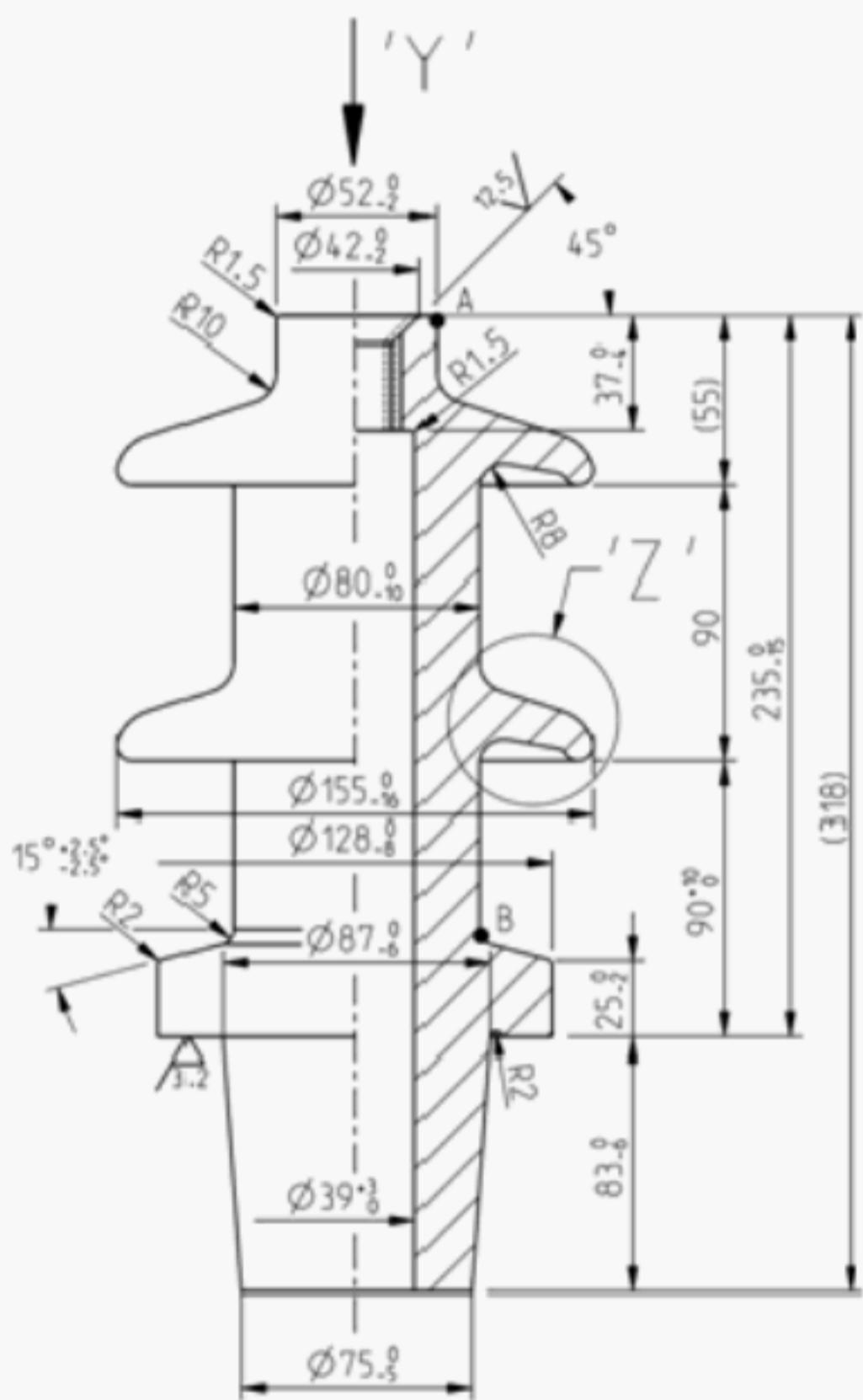


Figure A.6 - Insulator (Item n°1), type 6
Calculated nominal distance AB of represented insulator 315 mm

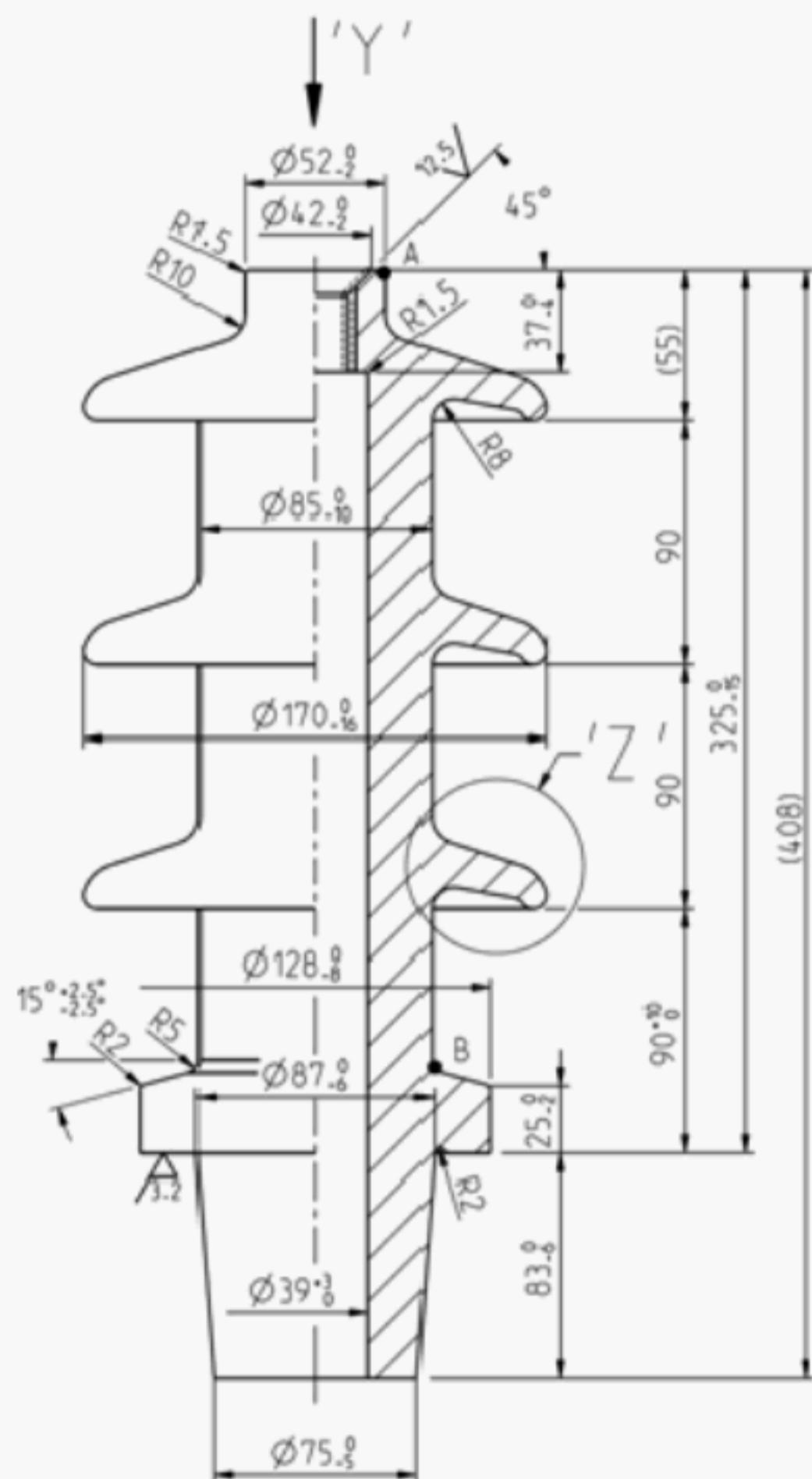
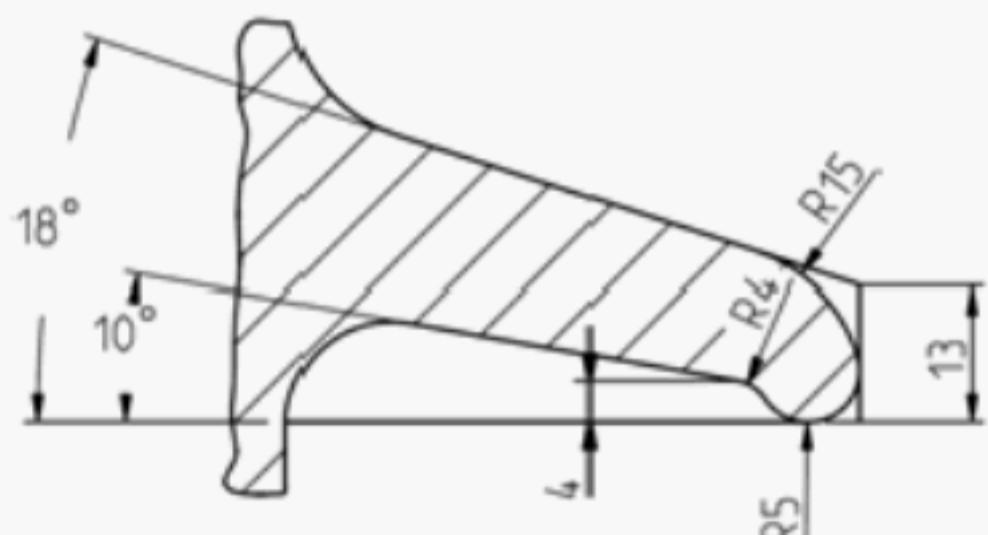


Figure A.7 - Insulator (Item n°1), type 7
Calculated nominal creepage distance AB of represented insulator 490 mm

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).

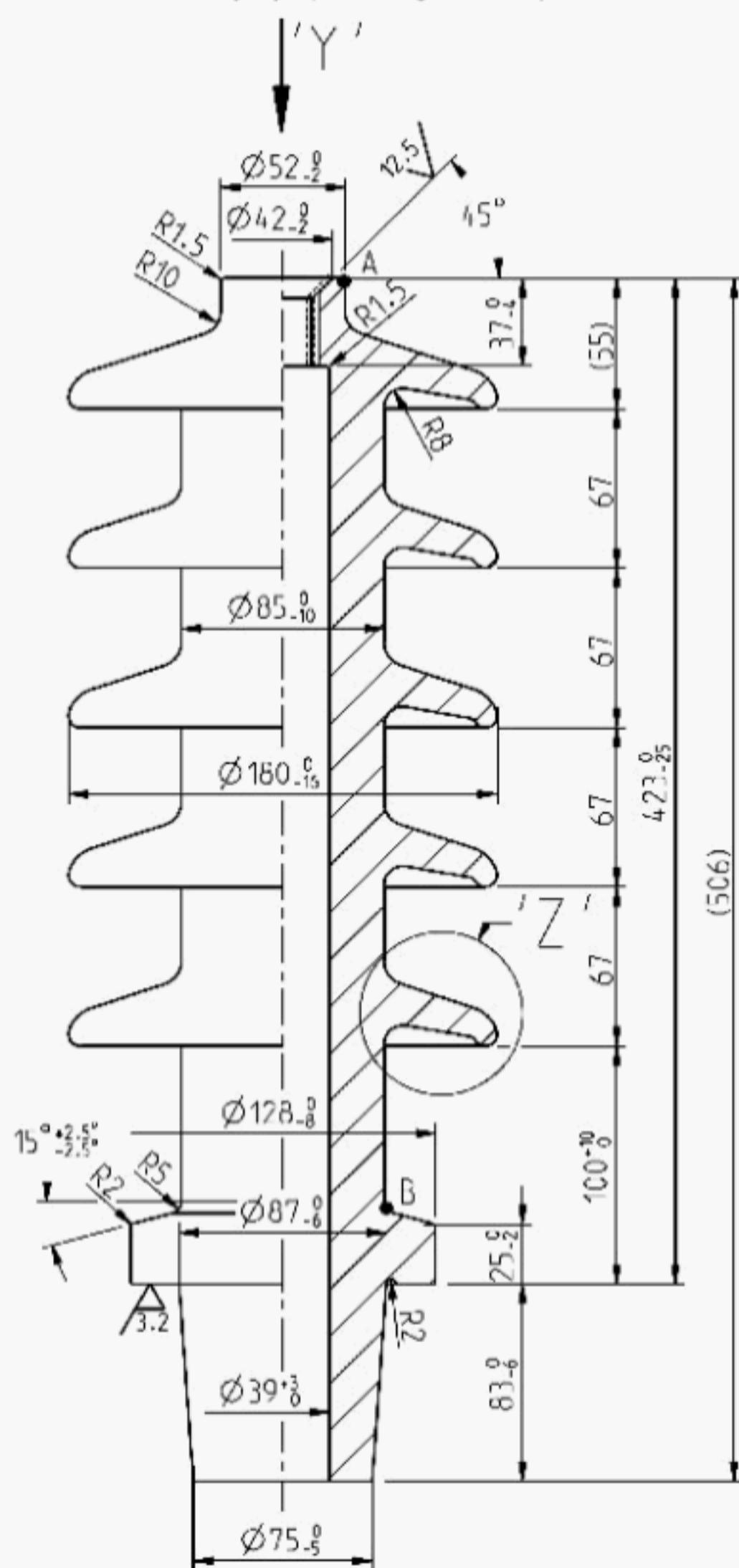
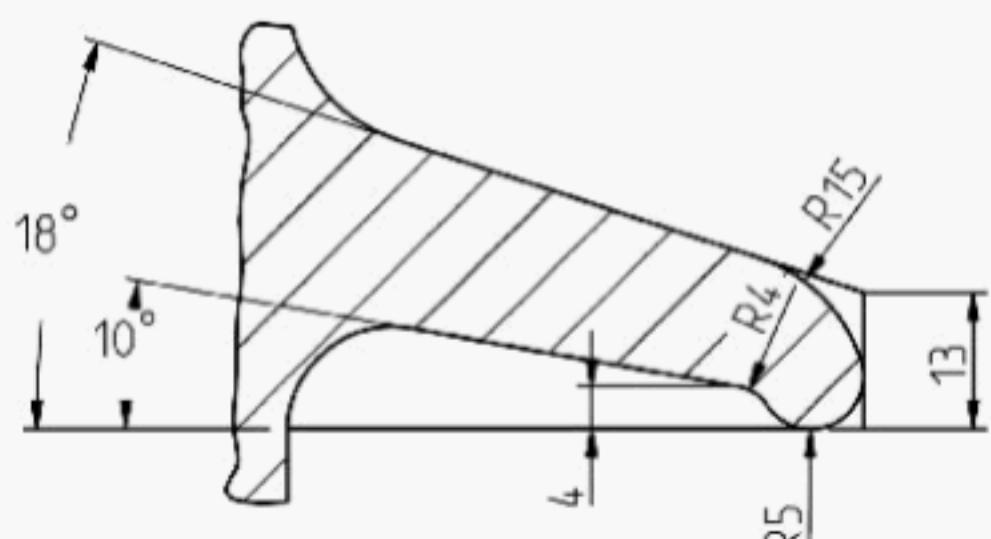


Figure A.8 - Insulator (Item n°1), type 8
Calculated nominal distance AB of represented insulator
760 mm

Detail 'Z'



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

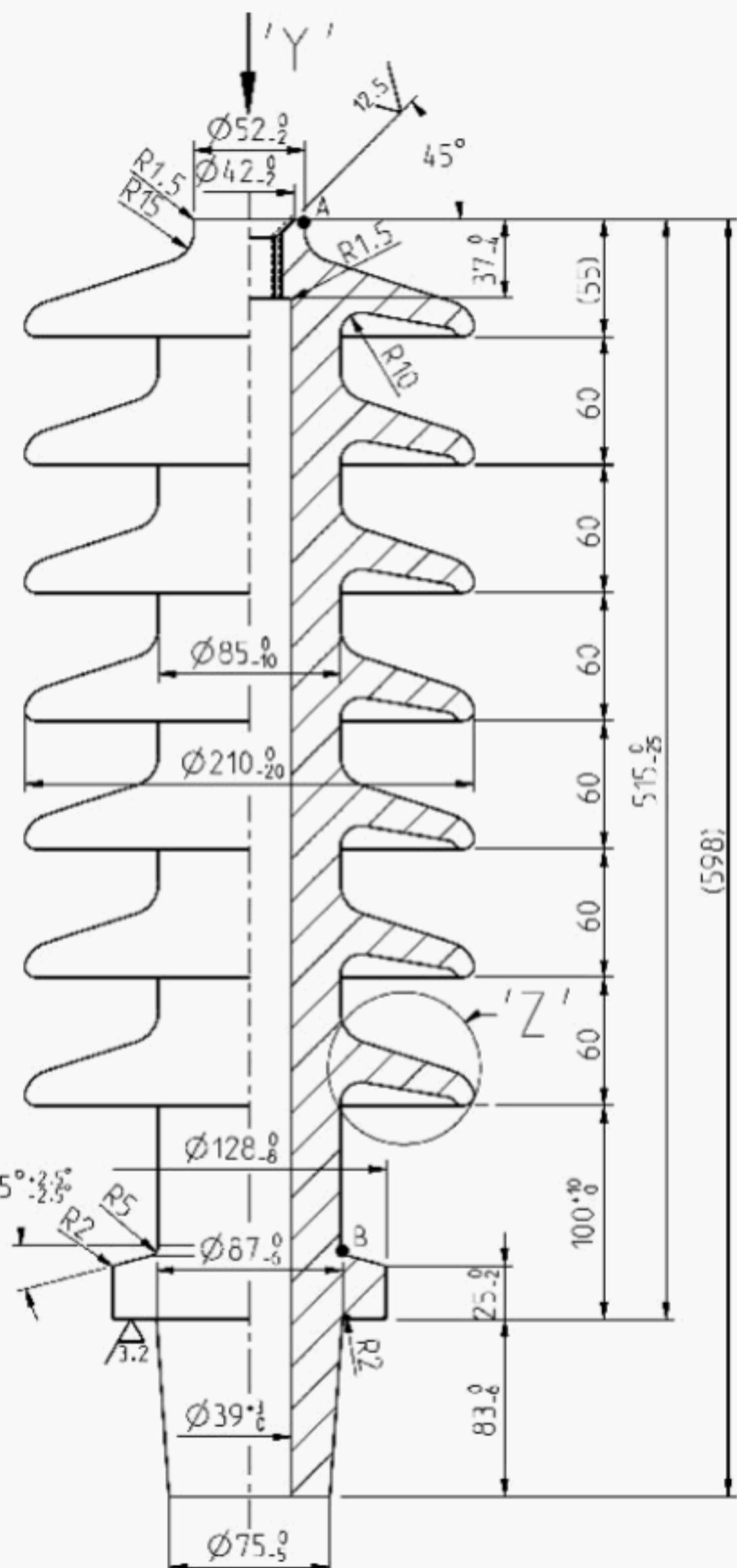
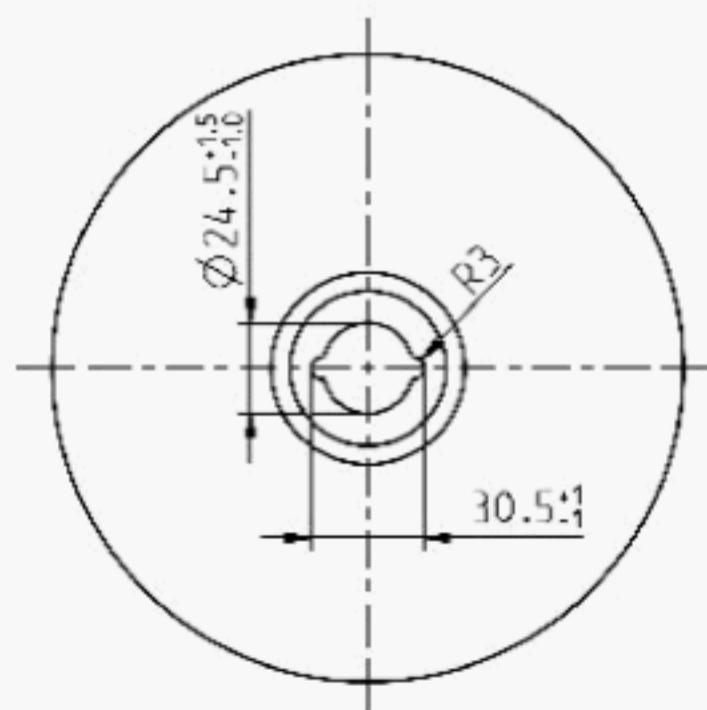


Figure A.9 - Insulator (Item n°1), type 9
Calculated nominal creepage distance AB of represented
insulator 1155 mm.

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 $\cdots\cdots\cdots$ (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

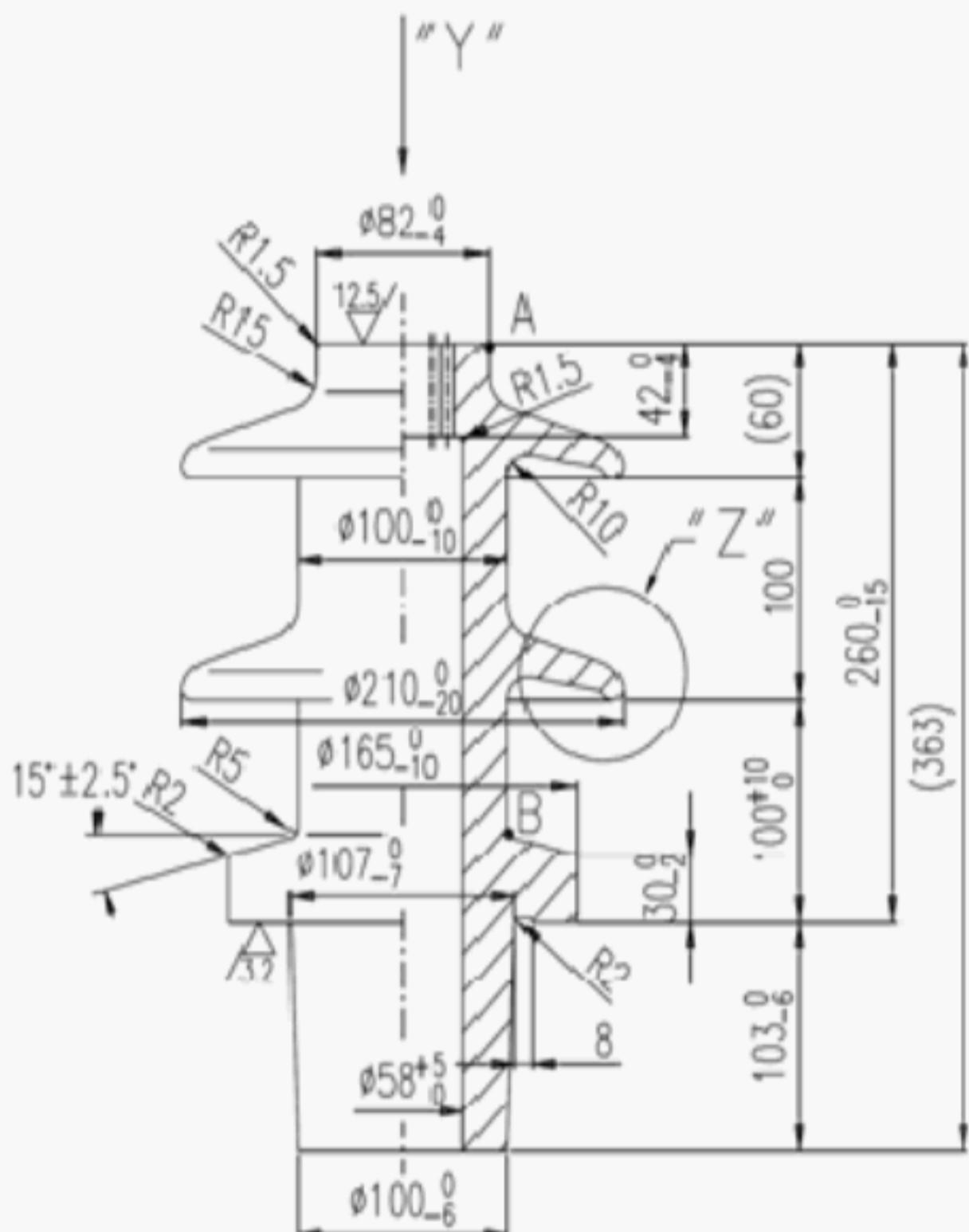


Figure A.10 - Insulator (Item n°1), type 21
Calculated nominal distance AB of represented insulator 385 mm

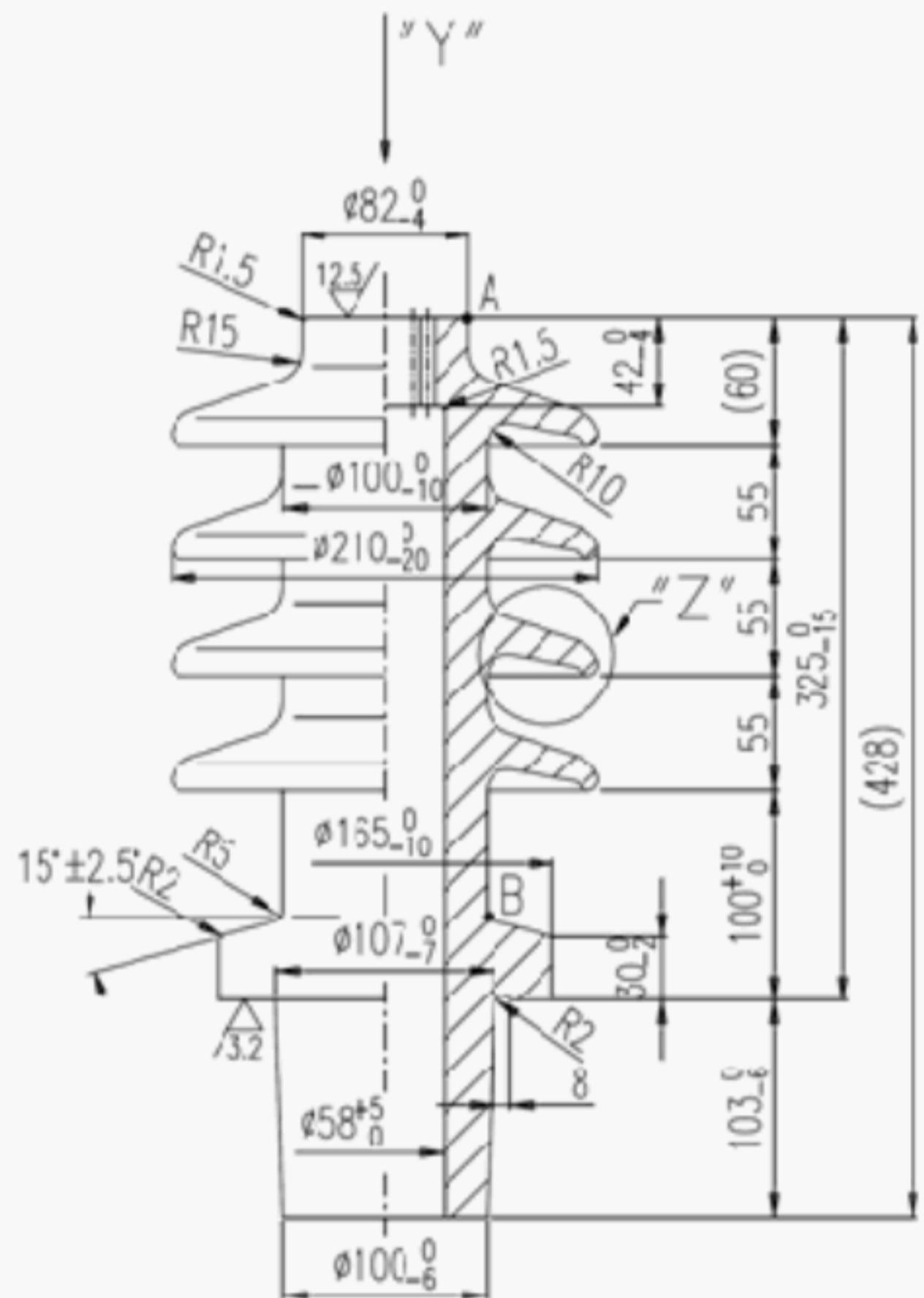
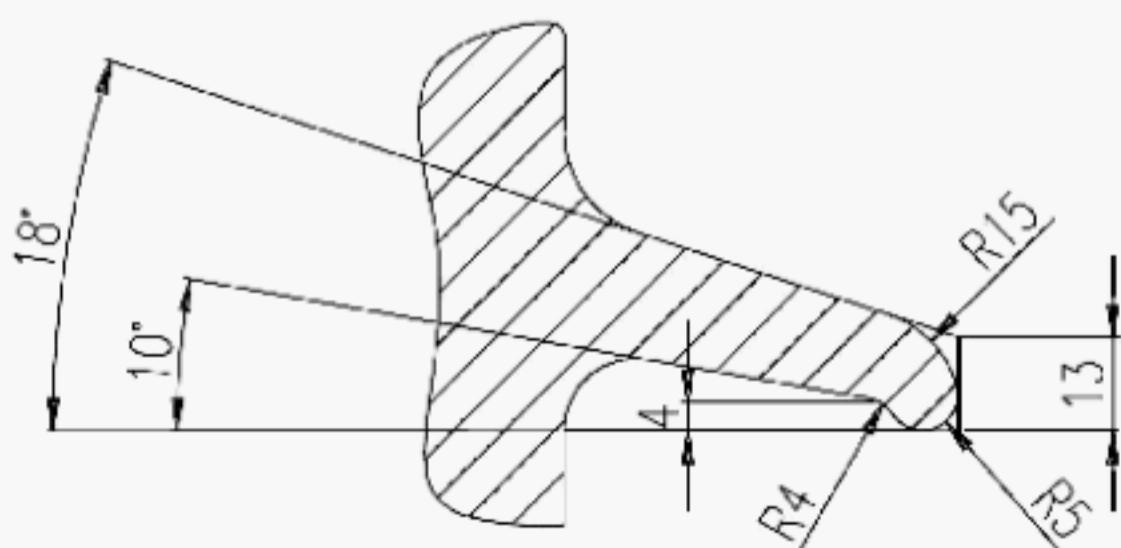
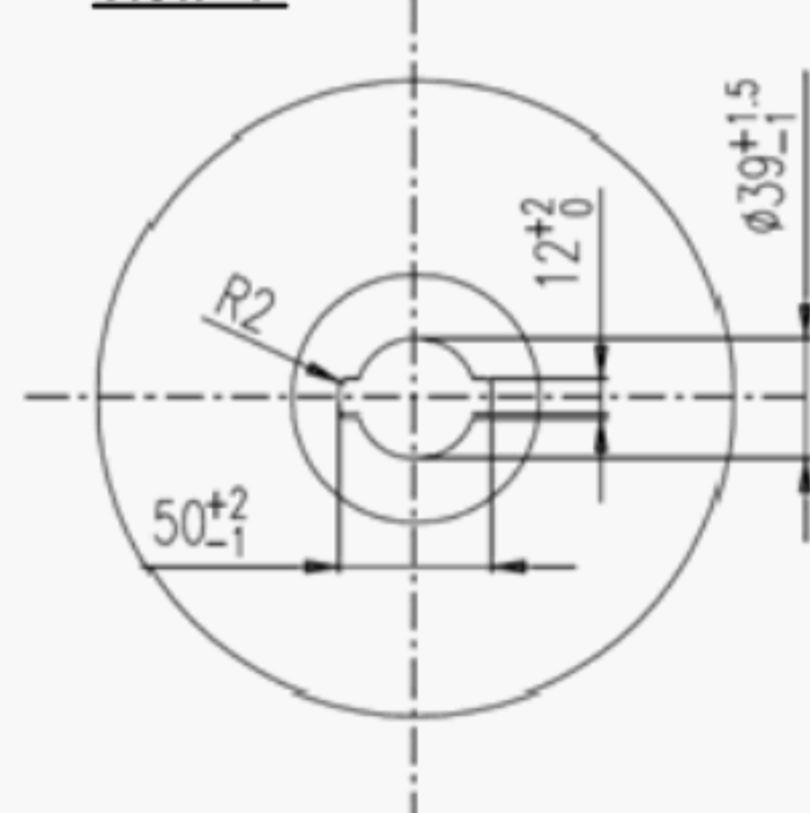


Figure A.11 - Insulator (Item n°1), type 22
Calculated nominal creepage distance AB of represented 620 mm

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 $\cdots\cdots\cdots$ (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

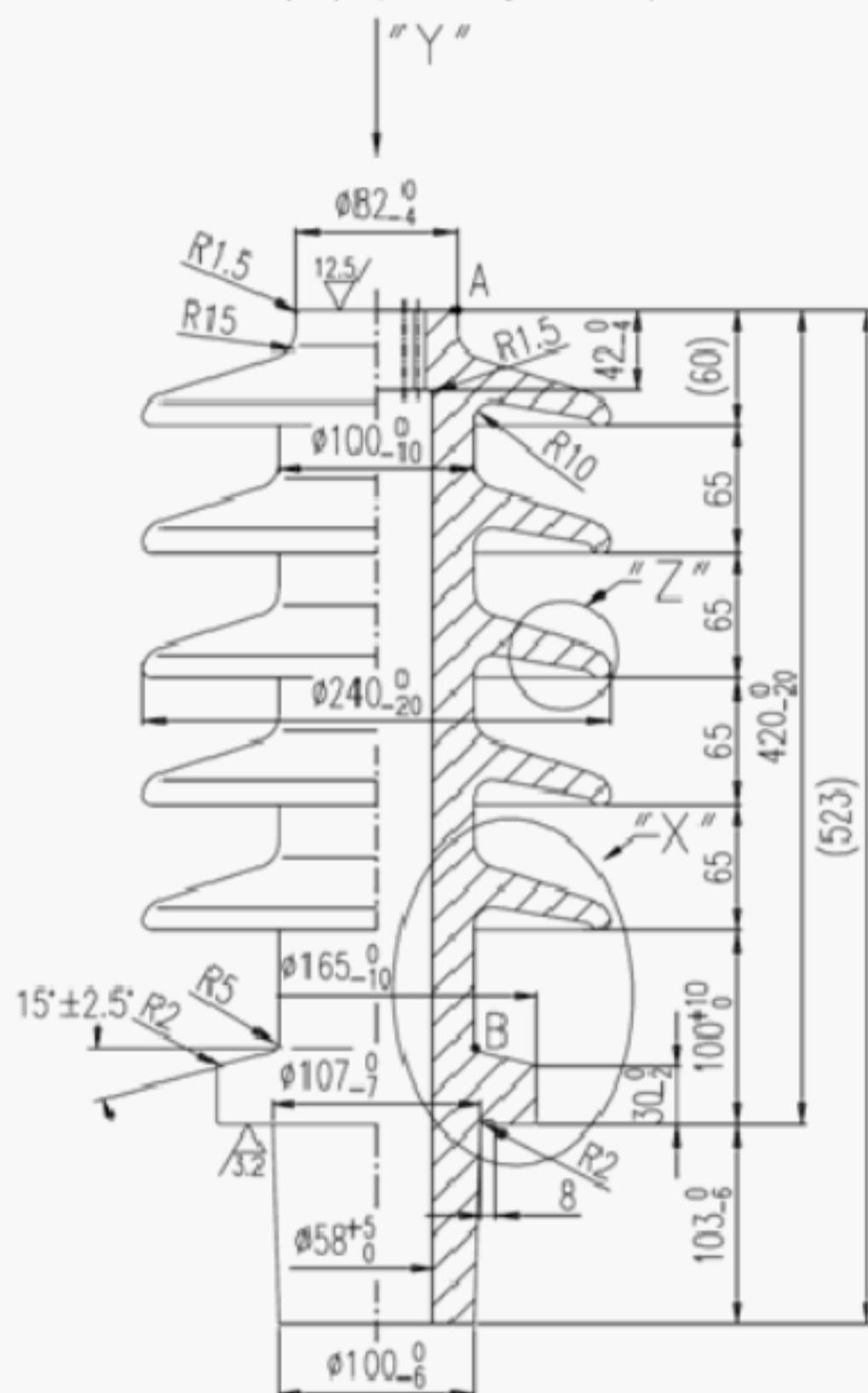


Figure A.12 - Insulator (Item n°1), type 23 & 23M
Calculated nominal distance AB of represented insulator 930 mm

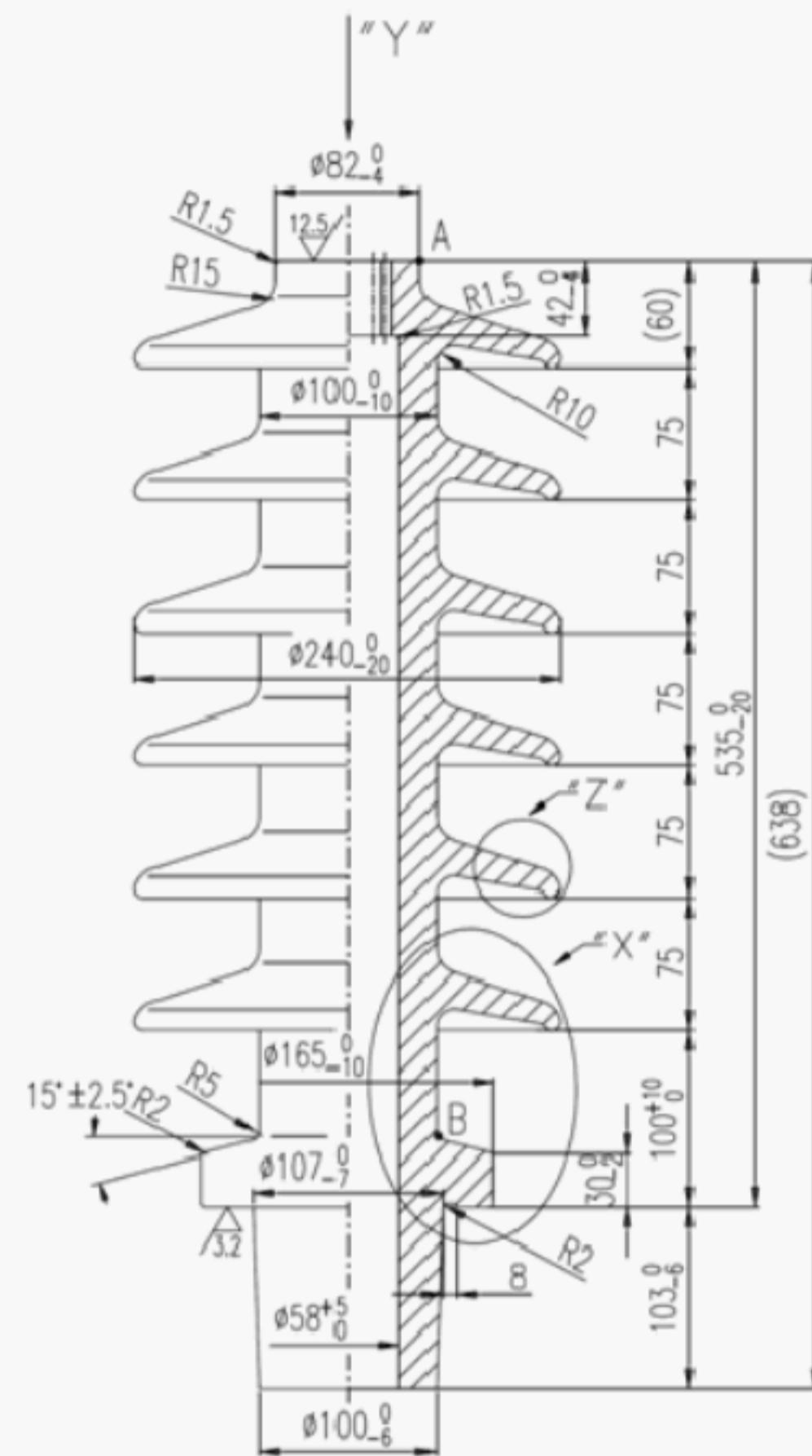
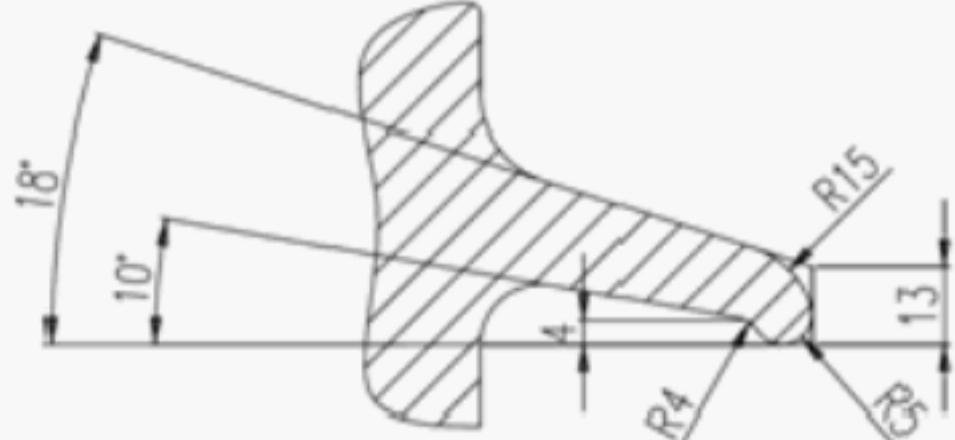


Figure A.13 - Insulator (Item n°1), type 24 & 24M
Calculated nominal creepage distance AB of represented insulator 1145 mm

Detail 'Z'

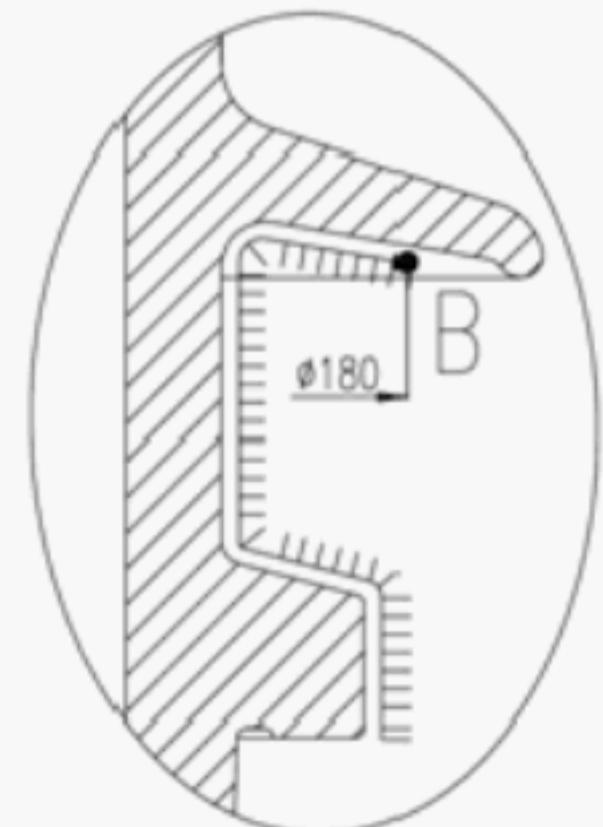


View 'Y'



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 $\cdots\cdots\cdots$ (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

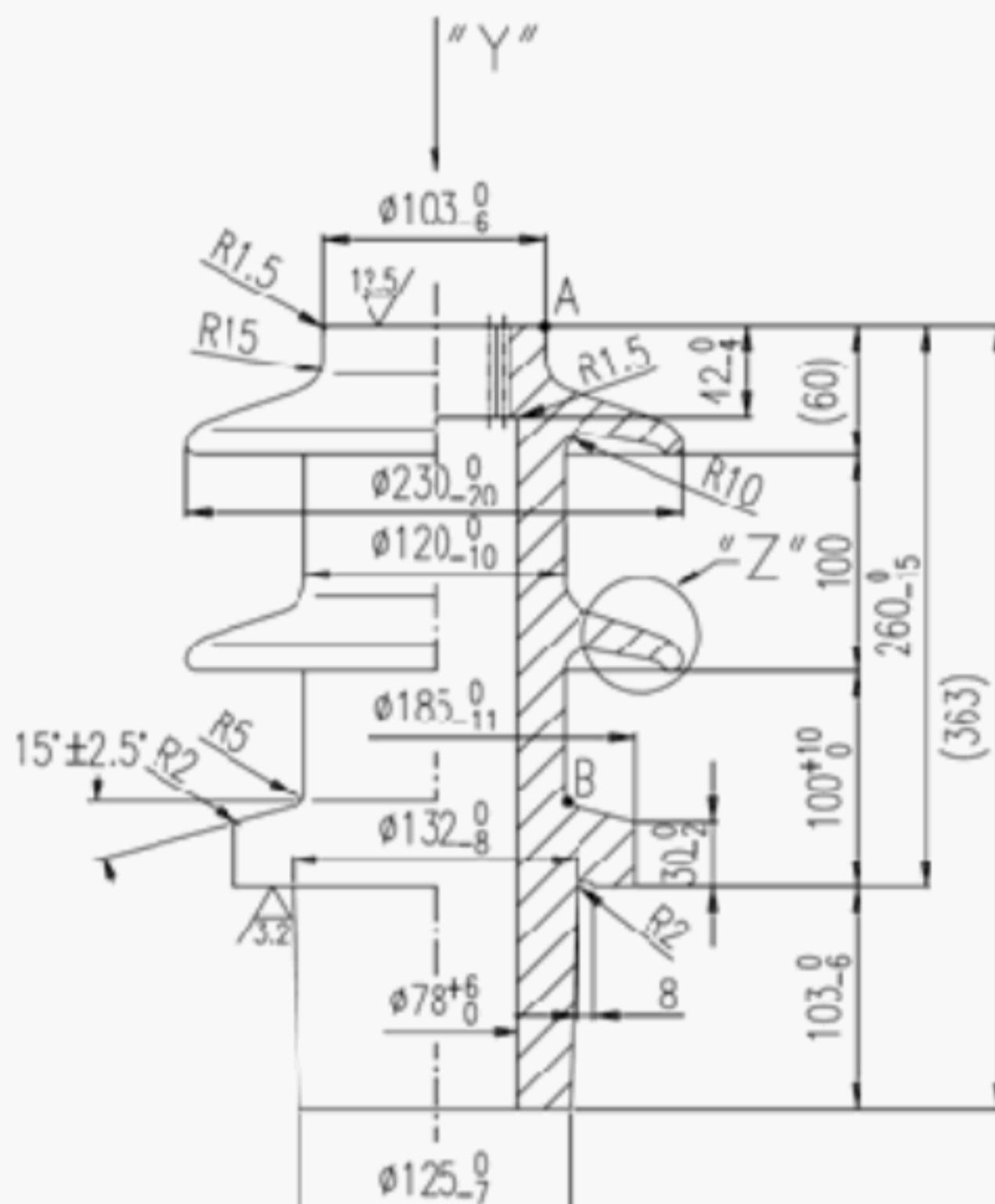


Figure A.14 - Insulator (Item n°1), type 25
Calculated nominal distance AB of represented insulator 385 mm

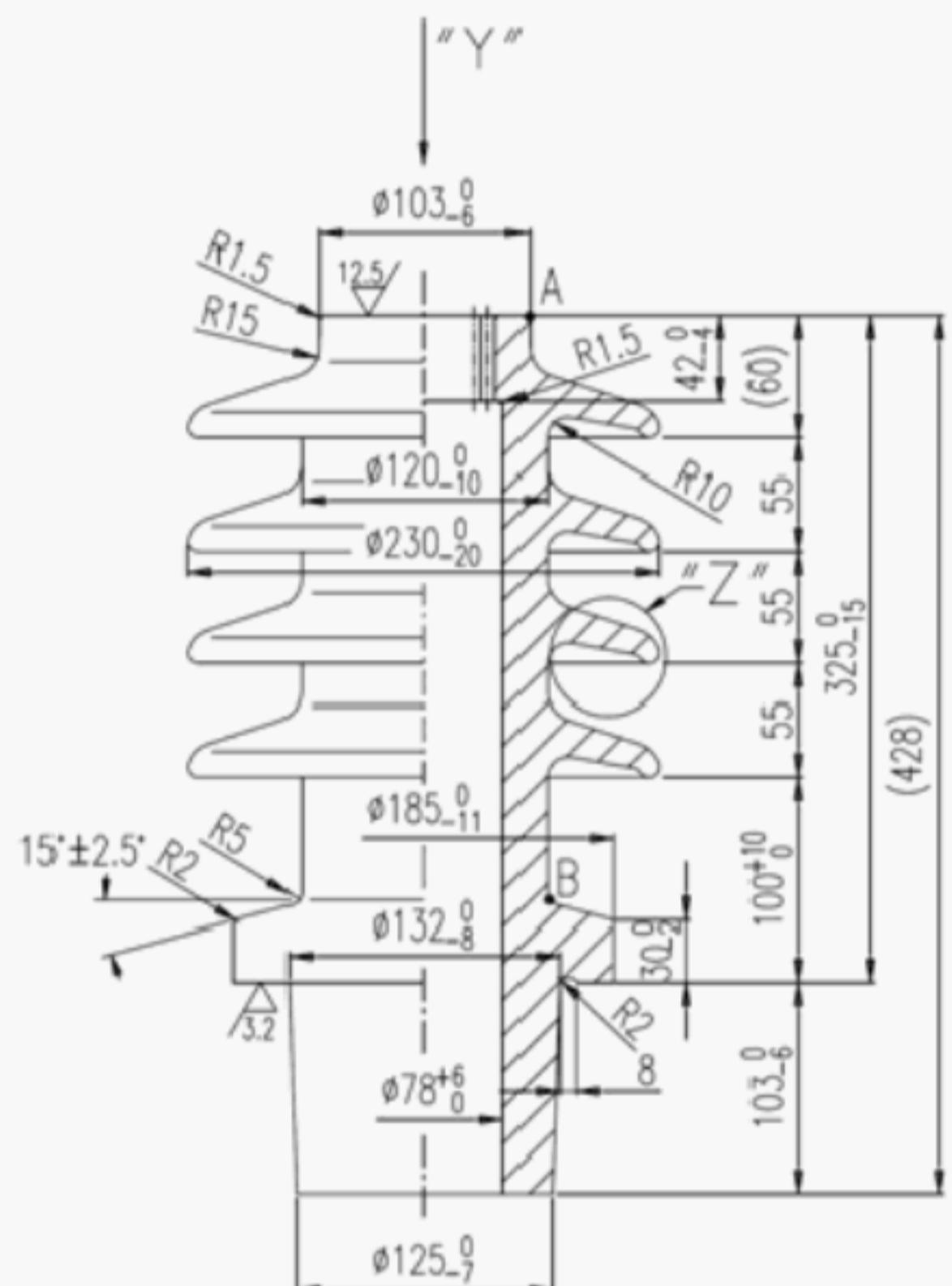
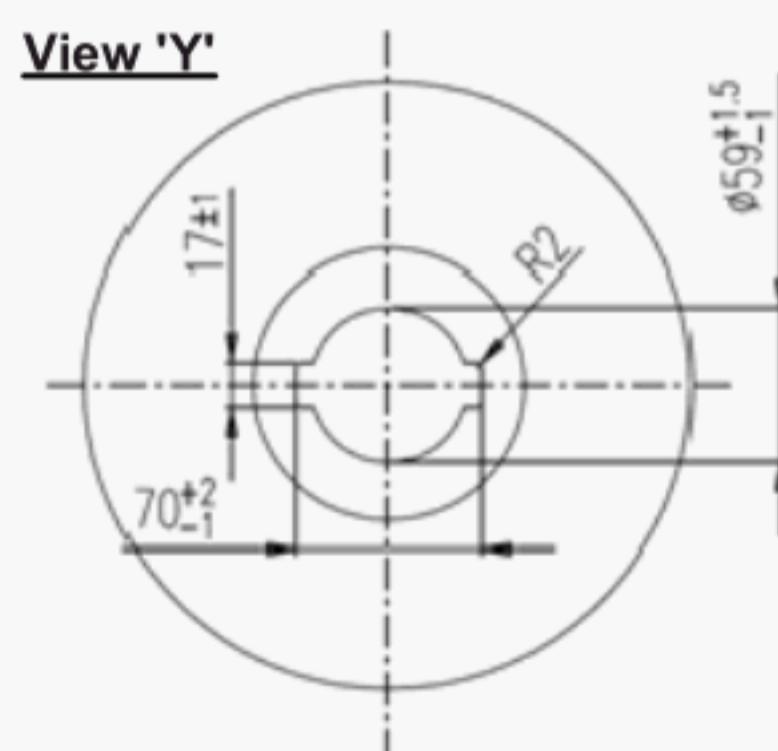
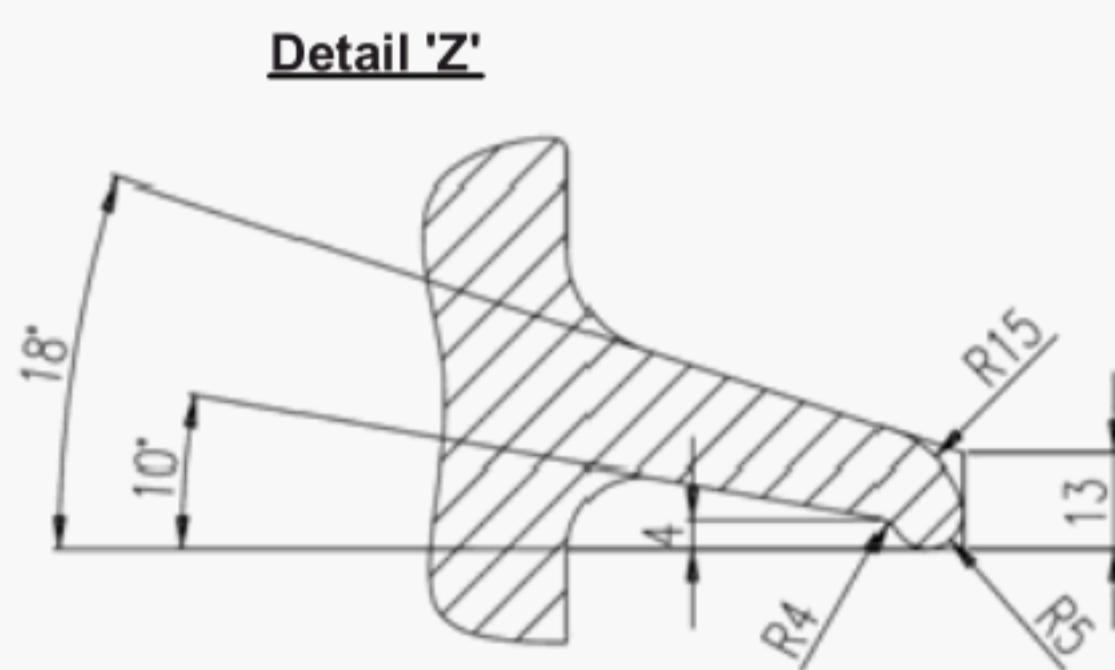


Figure A.15 - Insulator (Item n°1), type 26
Calculated nominal creepage distance AB of represented 620 mm

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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 $\cdots\cdots\cdots$ (other kind of surface for inner hole and lower extremity by special agreement).

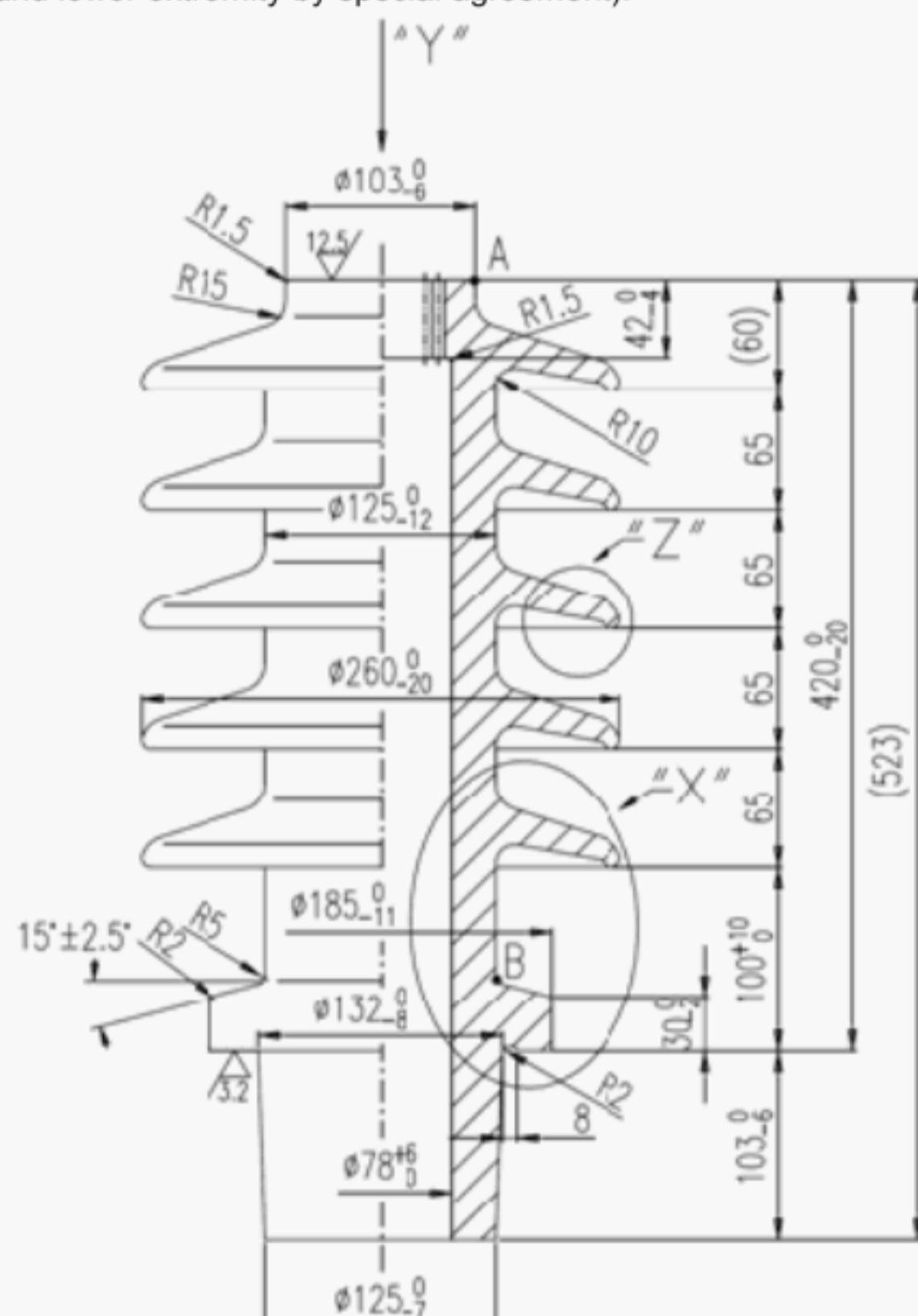


Figure A.16 - Insulator (Item n°1), type 27&27M
Calculated nominal distance AB of represented insulator 920 mm

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

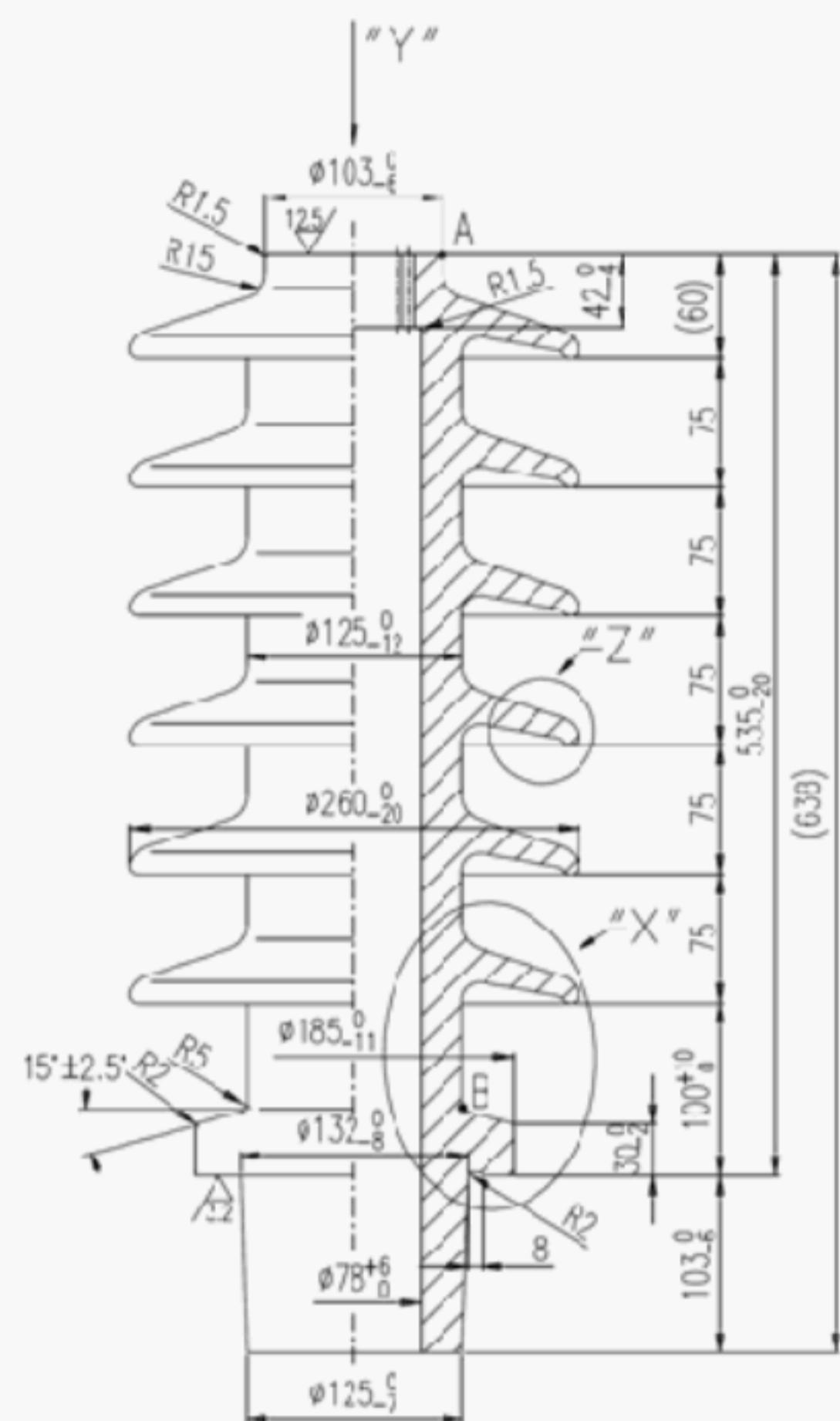
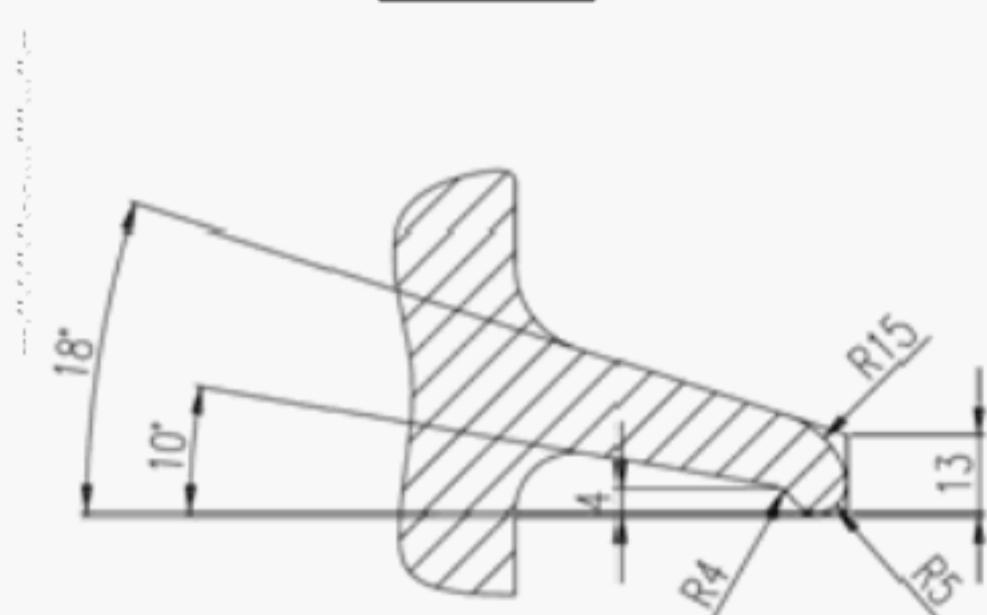


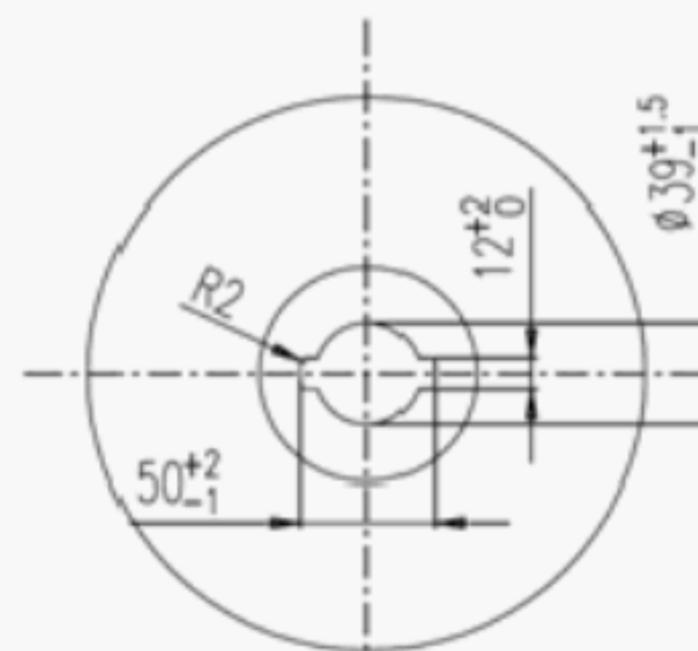
Figure A.17 - Insulator (Item n°1), type 28 & 28M
Calculated nominal creepage distance AB of represented 1135 mm

Detail 'Z'



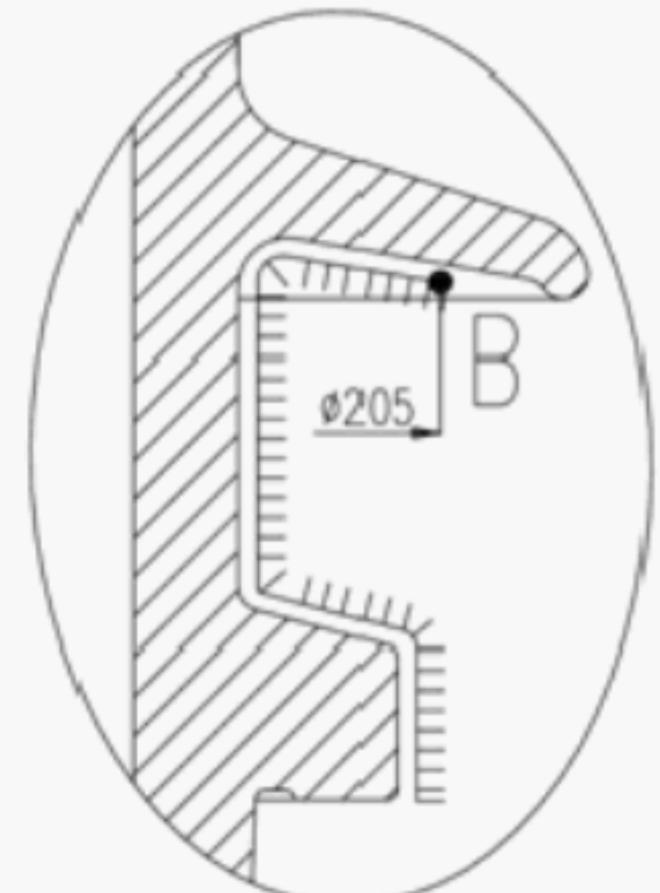
NOTE The same porcelain with metallization are named type 27M and 28M.
Calculated nominal creepage distances: for 27M is 830 mm and for 28M is 1 045 mm.

View 'Y'



Detail 'X'

Only on models 27M and 28M



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)

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

EN 62155
Surface marked with | | | | | are metalized (or equivalent).
Calculated nominal creepage distance of corrugated form in oil is
185 mm.

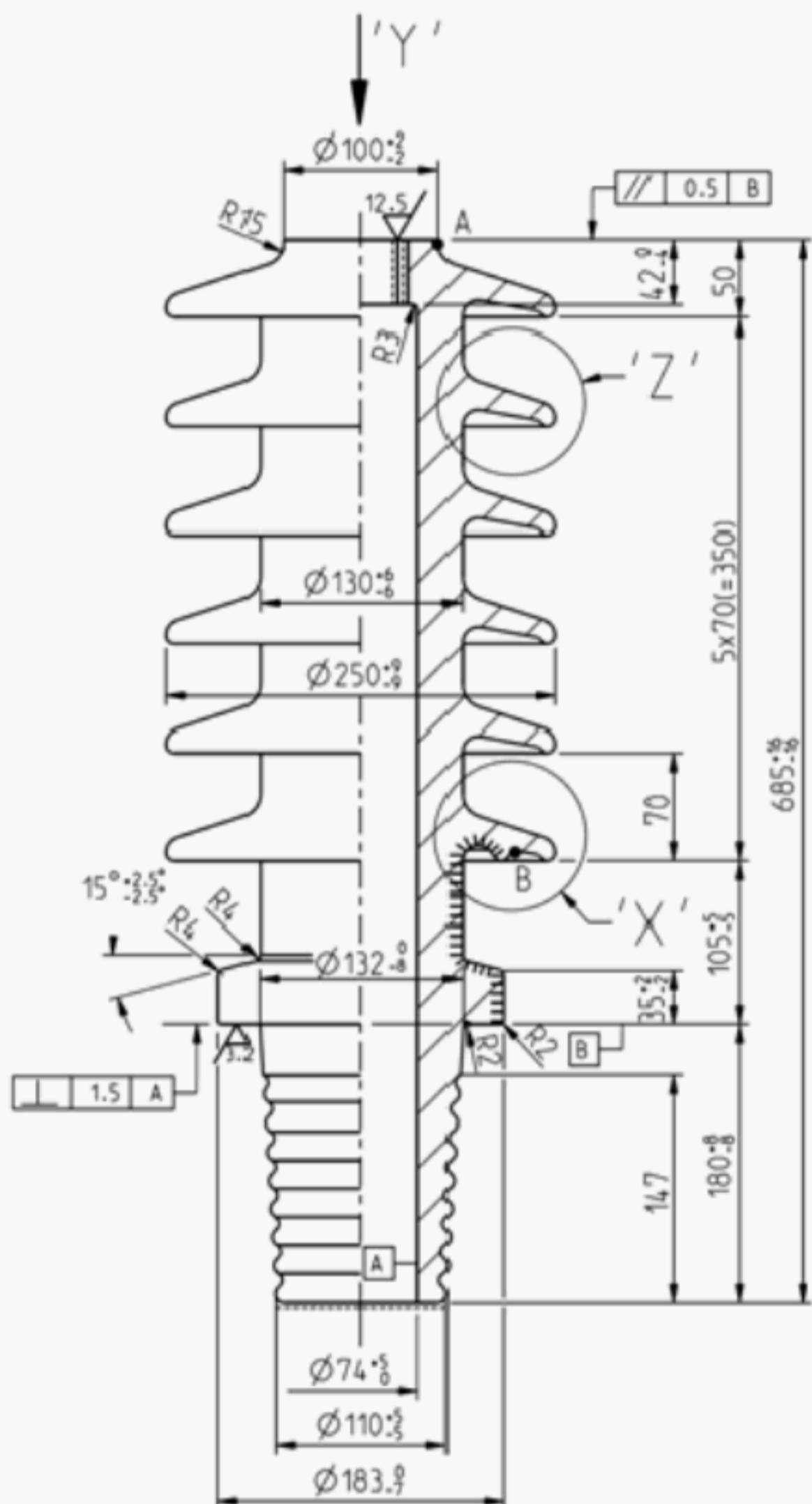
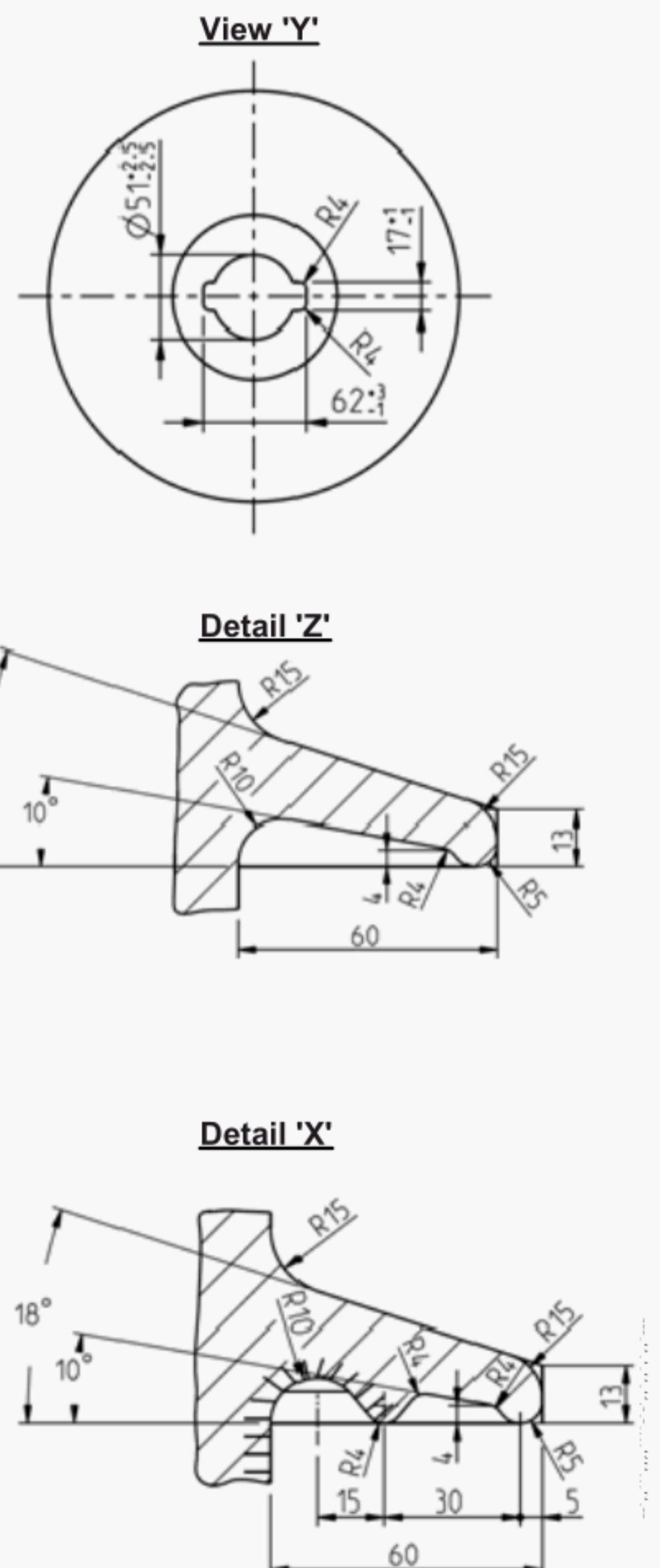


Figure A.18 - Insulator (Item n°1), type 29

Calculated nominal creepage distance AB of represented insulator
950 mm



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 $\cdots\cdots\cdots$ (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 $\underline{\underline{\underline{\underline{\underline{}}}}}$ are metallized

Calculated nominal creepage distance of corrugated form in oil is 185 mm.

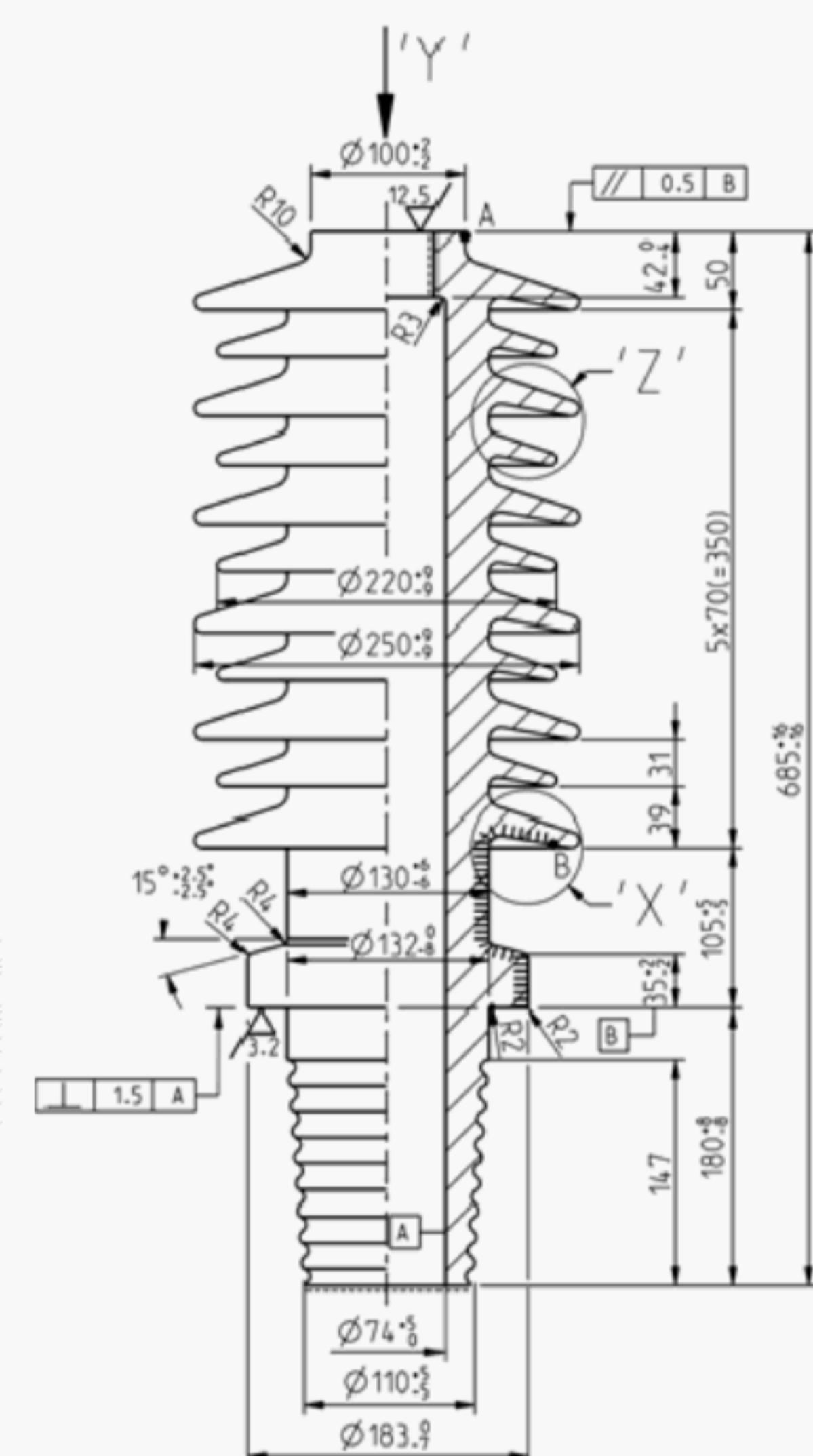


Figure A.19 - Insulator (Item n°1), type 30

Calculated nominal creepage distance AB of represented insulator 1350 mm

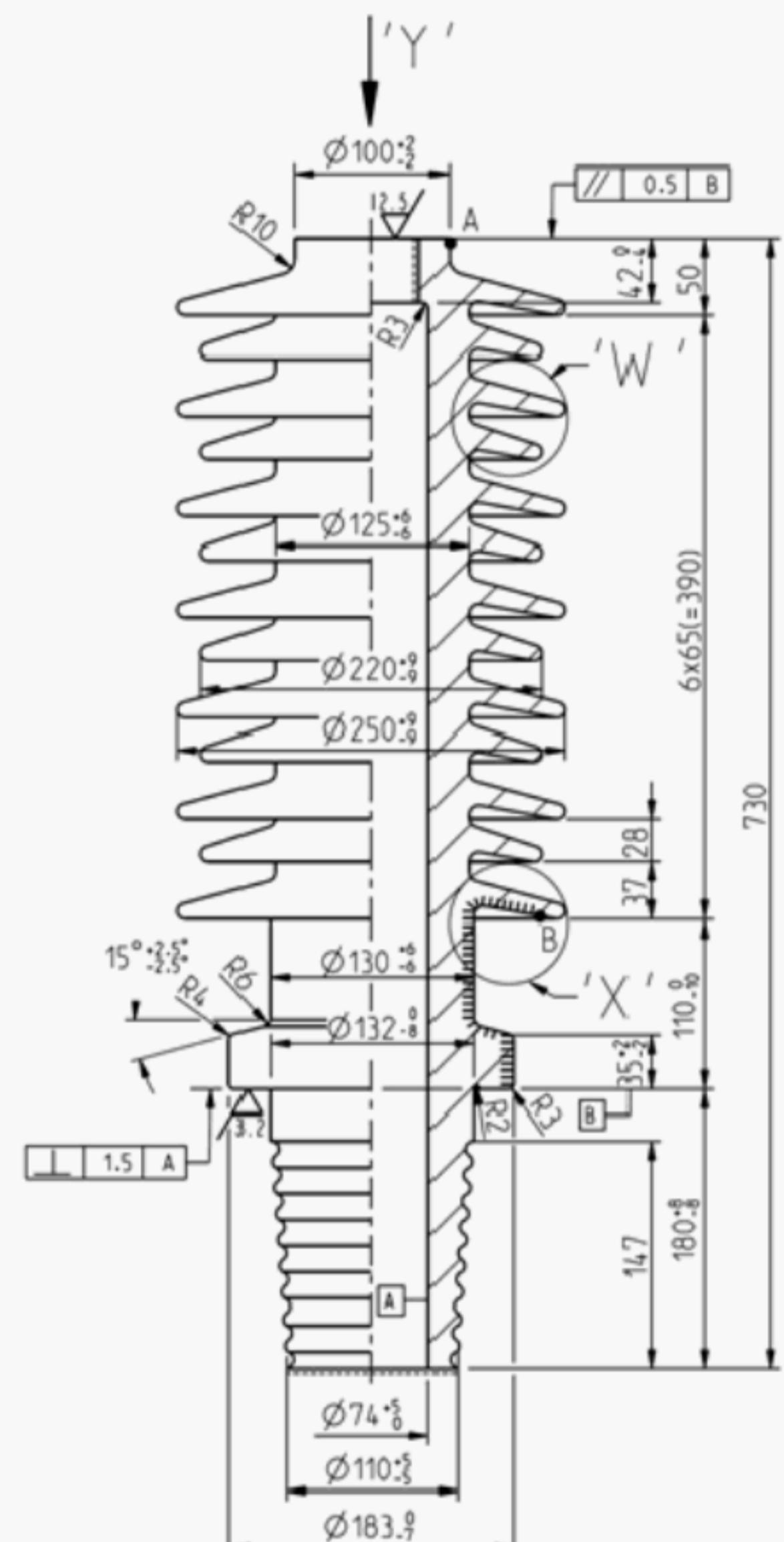
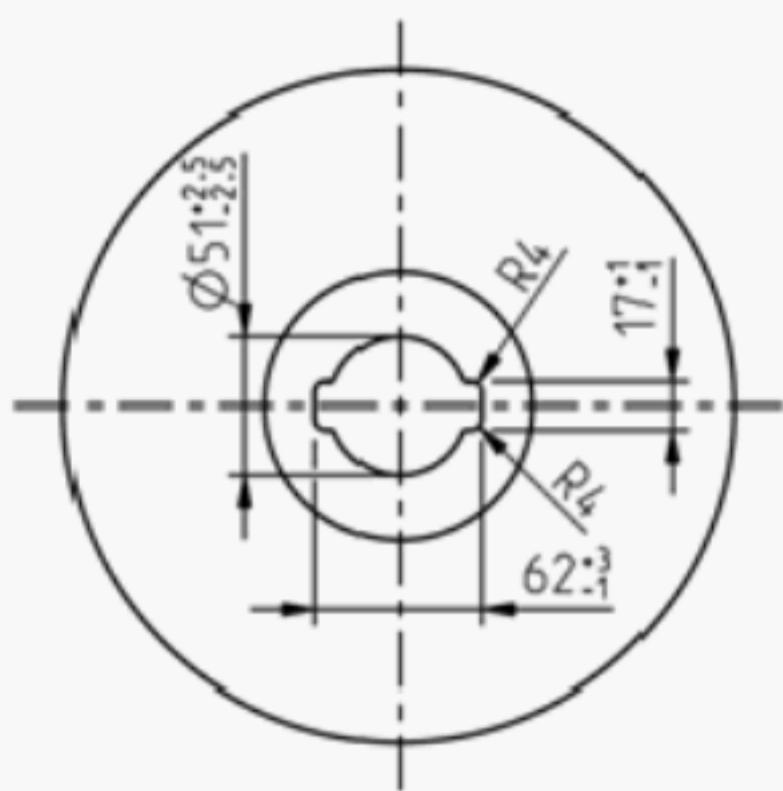
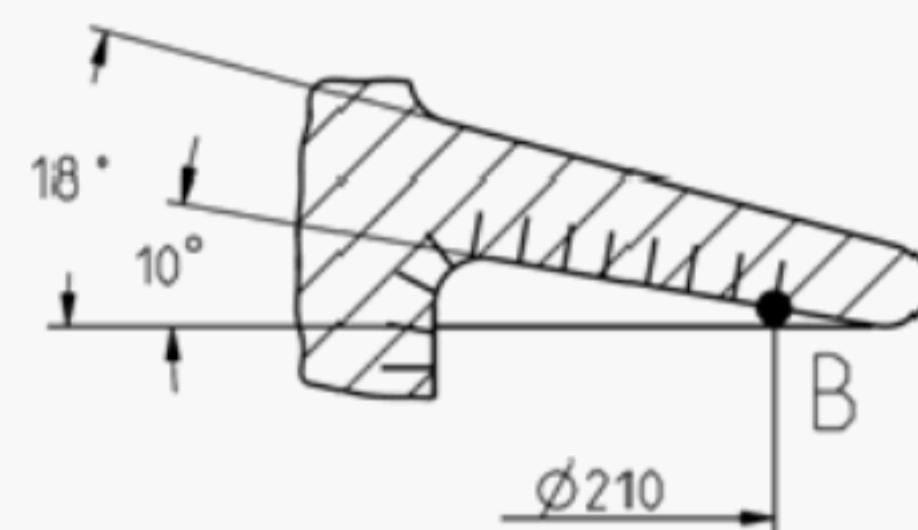
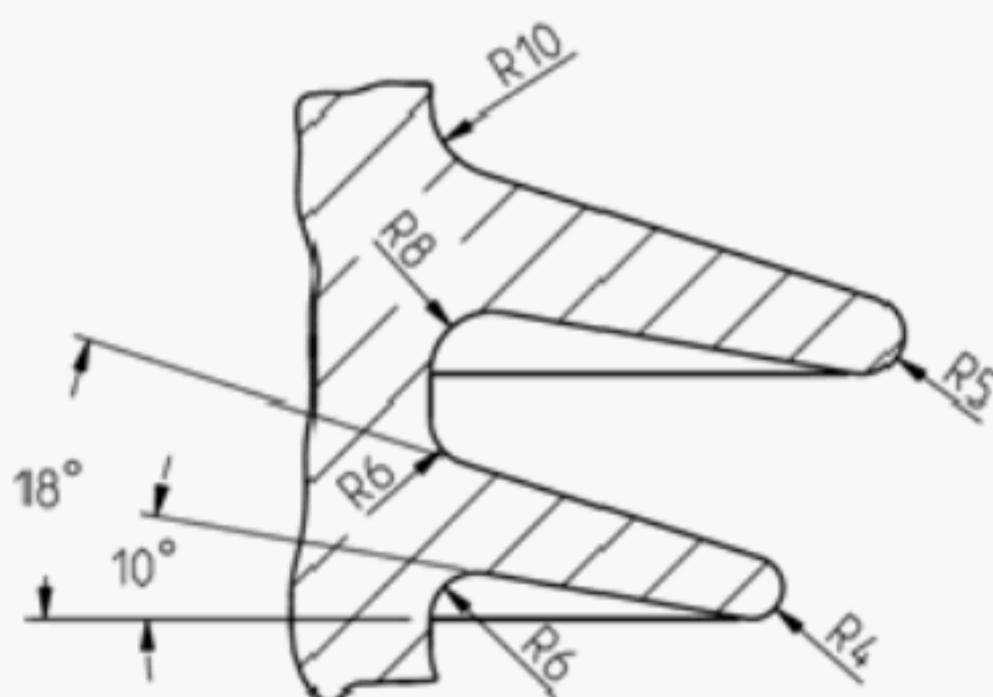
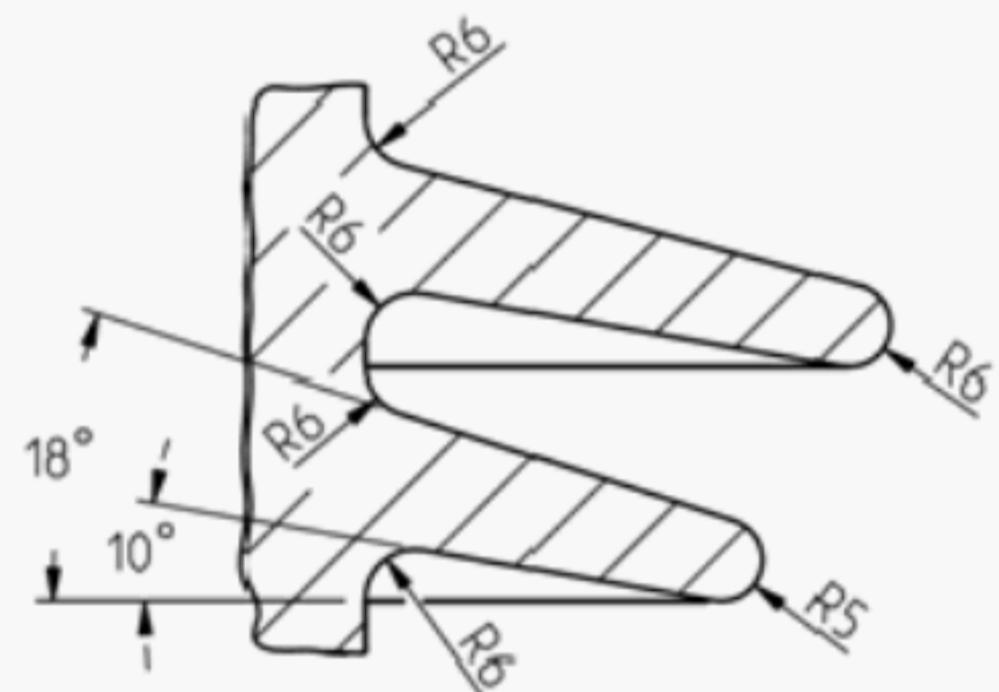
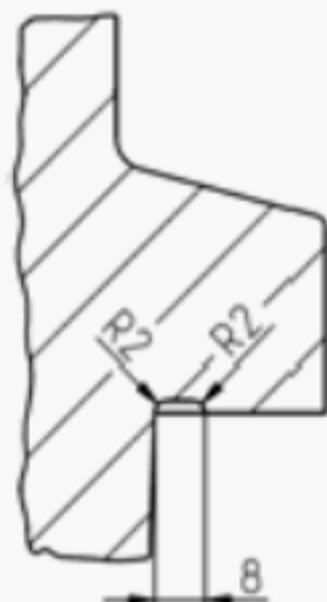


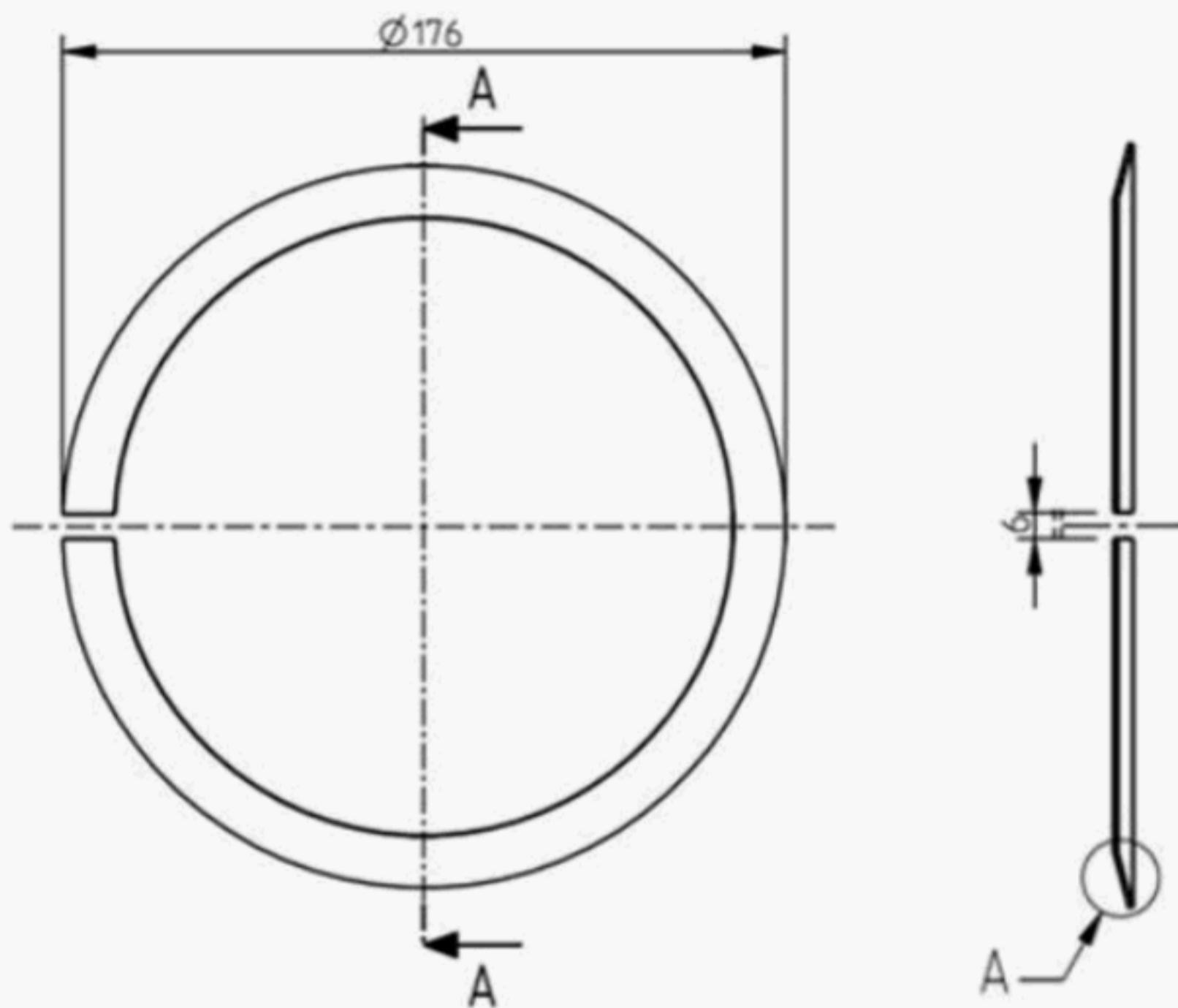
Figure A.20 - Insulator (Item n°1), type 31

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'**